ARMY ORDNANCE

VOL. XVI, No. 94 JANUARY-FEBRUARY, 1936

Lawrence and the Arab Revolt

Hoffman Nickerson

Our Defense Needs

Brig. Gen. John Ross Delafield

Ordnance of the Confederacy

Notes of Brig. Gen. Josiah Gorgas, C. S. A.

The Basic Biologic Aspect of War

Leon A. Fox

Oil and Our National Defense

B. T. Brooks and L. C. Snider

The Five-Year Program

An Editorial

A BIMONTHLY REVIEW OF AMERICAN MUNITIONS
PUBLISHED BY THE ARMY ORDNANCE ASSOCIATION, WASHINGTON, D. C.

Valves
BUILT FOR THE AGES..
for the World's Highest Dam!

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5	74,500	100,500	33.6	60.4
6	73,500	100,000	33.6	60.4
2	78,000	103,000	32.8	60.4
3	77,500	102,000	34.5	57.9
4	78,500	102,000	33.6	59.8
7	73,000	100,000	35.5	63.6
9	76,500	101,500	34.5	63.1
8	77,000	102,500	30 1	65.0
10	77,000	101,500	36.0	63.1
11	77,000	102,000	34.0	61.8

IN BOULDER DAM, the use of Monel Metal was determined by two factors:

1. The metal's demonstrated ability to withstand corrosion, its rust-proofness, and its resistance to the gnawing forces of erosion.
2. The uniformity of mechanical properties as determined by engineers of the U. S. Bureau of Reclamation at Denver in a series of earlier tests shown by the table at the left.

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ARMY ORDNANCE

The Journal of the Army Ordnance Association

Now in its Sixteenth Year of Publication

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guaranty of Peace

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"The other great nations have not hesitated to adopt the required means to develop their shipping as a factor in national defense and as one of the surest and speediest means of obtaining for their producers a share in foreign markets. Like vigilance and effort on our part cannot fail to improve our situation which is regarded with humiliation at home and surprise abroad. Even the seeming sacrifices, which at the beginning may be involved, will be offset later by more than equivalent gains."—*President William McKinley, Special Message to Congress, December 5, 1899.*

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The Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

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Photo: U. S. Army Air Corps

MAJOR GENERAL OSCAR WESTOVER
Chief of Air Corps, U. S. Army

ARMY ORDNANCE

Volume XVI JANUARY-FEBRUARY, 1936 No. 94

Lawrence and the Arab Revolt

An Outline of the "Seven Pillars of Wisdom"

By Hoffman Nickerson*

ALTHOUGH Lawrence of Arabia owed his fame to his successful leadership of the Arab Revolt against Turkey during the last two years of the war of 1914-'18, yet the six hundred and fifty pages of his "Seven Pillars of Wisdom" contain so much non-military matter that the student of war must go over the long book with some care to see just what this strange man thought and did in his capacity of commander. Lawrence was a lover of epic hero-poems, in Arabia Malory's "Morte d'Arthur" seems to have been the only book in his saddle bags and he afterward translated the Odyssey. His book is in part a prose epic and only in part a study of operations. Moreover he often fails to give us essential dates and figures which must be supplied from Liddell Hart's "Colonel Lawrence".

Lawrence was a highly educated man who had read enormously. Among other subjects, he had done much work on the history and theory of war. Years of archaeology and of roughing it in the Levant had given him an intimate knowledge of the peoples and languages of the Near East, especially in Syria and Mesopotamia, the two chief Arabic-speaking provinces of the Turkish Empire. Thus he appreciated the internal weakness of that Empire, and when in 1914 Turkey declared war against England and her Allies he believed that an Arab revolt might destroy the Ottoman state altogether.

In June 1916 the Arabs did rise, not in Mesopotamia or Syria where the Turks were then too strong for open opposition, but in the Hejaz, a coastal district east of the Red Sea. The Hejaz included the two Moslem holy cities of Mecca and Medina. Led by Hussein, Emir of Mecca and head of the great Sherifian Clan who are descended from Mohammed, the rebels took Mecca and moved on Medina, only to be driven back from the latter place by the Turks.

Incidentally the barbarity of the Turks, like most exhibitions of "frightfulness" throughout history, played into the hands of their enemies. In the fighting around Mecca they shelled the mosque of the Kaaba itself, killing some worshippers and narrowly missing the Black Stone which is the Holy of Holies of Islam. Further, the Arabs, a poor people whose chief amusement was intertribal war, had ironclad rules to govern that favorite sport. Women and children were not to be killed, raped, or otherwise harmed, and property which could not be carried away must be left undamaged. Had the Turks observed these precepts their Medina victory might have brought down the entire Hejaz revolt. Instead they stiffened Arab resistance by orgies of bestial outrages.

THE war waged by the Arab rebels against Turkey divides naturally into two phases: in the first the Arabs operated separately from the British army based upon Egypt, serving as a distant distraction to draw off Turks who would otherwise have been free to oppose that army. Meanwhile Lawrence came to the Hejaz, soon made himself an important position there, and by his capture of Akaba in July 1917 concluded the first phase. In the second, from the taking of Akaba to the Armistice with Turkey in October 1918, the Arabs coöperated closely with the British.

In Egypt British councils were at first divided both as to the military value of the Arabs and as to the best means of supporting them, if indeed they were worth supporting at all. Lawrence, a temporary second lieutenant on Intelligence duty, was hotly of the pro-Arab party, and in October 1916 he seized the opportunity of accompanying a superior British officer on a visit to the Hejaz.

The strategic topography of Asiatic Turkey, an ill developed country with few main roads and practically no motor traffic, was determined by its railroads. These formed an immense T of which the crossbar—interrupted by several not yet finished links—ran in a general direction east from Constantinople some twelve hundred miles to Basra on the Persian Gulf. The upright bar of the T left the crossbar at the north-Syrian city of Aleppo and ran southward, throwing out certain branches in Syria and Palestine and then running on branchless for some seven hundred and fifty miles until it ended at Medina about a thousand miles from Aleppo. Thus Medina was the Turkish railhead in the Hejaz, and from it they began to push back the Arab irregulars who received their scanty supplies from the British through the Red Sea ports adjacent to Mecca and Medina.

Shortly after landing, Lawrence was sent up country to inspect the army commanded by Feisal, the aged Emir Hussein's third son. He reported favorably on Feisal's character and abilities, judging him to be the best of the Arab leaders. The Arab Army was an informal affair, loosely organized on a tribal basis with a small nucleus of newly formed regulars under Turkish-trained officers. The men, however, were extremely hardy, mobile, and in good spirits. Individually courageous, their weaknesses were indiscipline and fear of the Turkish artillery, chiefly because of its noise. One is reminded of the host of passages in Sixteenth Century European literature—Shakespeare, Rabelais, Ariosto—vehemently expressing a like horror of the then new cannon.

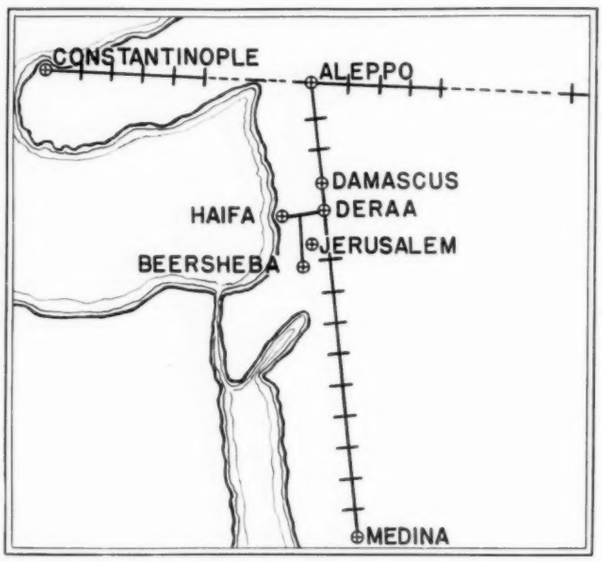
Lawrence's first idea was to keep the Arabs on the de-

*Author: "The Inquisition, A Political and Military Study of Its Establishment," 1923; "Warfare" (with Snalding and Wright), 1925; "The Turning Point of the Revolution," 1928; "The American Rich," 1930; "Can We Limit War," 1934. First Lieut., New York National Guard, 1916; Captain, Ordnance Department, U. S. Army, 1917; Duty with General Staff, A.E.F., 1918; Member U. S. Section, Inter-Allied Armistice Commission, Spa, Belgium, 1918-1919.

fensive. He judged their loose organization and slack discipline insufficient to stand the strain of the losses inseparable from serious offensive fighting. But he thought that if provided with Lewis guns and artillery they could hold the difficult gorges of their hills.

Two checks suffered by the Arabs soon disproved their defensive value. Certain tribes showed signs of going over to the Turks who came forward with increased confidence, threatening Yenbo, the northernmost of the Arab Red Sea ports. Should these go, the rebellion would collapse.

At this point the British military mission to the Arabs took the bold decision that Feisal, instead of retreating about a hundred miles down the coast from Yenbo in order to concentrate the Arab defence around the next port, Rabegh, should take the offensive, move rapidly some two hundred miles northwest along the Red Sea littoral, and take the harbor town of Wejh. A local success there was morally certain for the place was lightly held. Strategically its occupation would permit the harassing of a long stretch of the Hejaz railway, the indispensable Turkish line of communication which paralleled the Red Sea coast down as far as Medina at an average distance of about a hundred miles from salt water. The Turkish army based upon Medina would then be thrown upon the defensive by the necessity of detaching largely in order to keep the railway running in the teeth of sudden Arab raids and demolitions here and there for about two hundred and fifty miles of its length. Politically the taking of Wejh would strengthen the revolt since it would nearly double the area of rebel occupation and permit Feisal to gain contact with the chiefs of doubtful and hesitating tribes. How far Lawrence was responsible for the move on Wejh we do not know; at least he heartily concurred in the decision.



General Outline of the Railroads of Yarmuk Valley, Arabia, 1917-1918.

Feisal was hard to persuade. The move was a gamble; it uncovered Yenbo and exposed Rabegh to grave risks should the Turks come on vigorously. He yielded only when promised abundant British naval help both for the proposed move on Wejh and in case of a Turkish attack on Rabegh, and when Lawrence suggested that other British detachments be used to harass the Turks about Medina and temporarily immobilize them there.

In the event the enemy did little. Their communications were difficult, doubly so because of the doubtful tribesmen, their heavy German equipment was unsuited for desert fighting, their sick rate was high, and altogether they found their difficulties greatly increased as they moved further from their ill equipped Medina base.

When finally persuaded, Feisal acted vigorously and with good judgment, marched rapidly on Wejh, receiving water and supplies from British ships along the way, and reached his objective only to find it in the hands of an Arab party who had been landed from the British ships and with naval aid had captured the tiny Turkish garrison. The Arab casualties had been twenty killed—at which Lawrence was annoyed, for the handful of Turks had had neither food nor transport and must therefore have yielded quickly to blockade.

The results of the move to Wejh were all that had been hoped. The accession of new tribes multiplied the number of active rebels, a more effective harassing of the railway by raids and temporary demolitions became possible. The Turks lost the initiative; they confined themselves to holding Medina and laboriously keeping the railway open—a job which compelled them to disperse larger and larger parts of their force in isolated blockhouses and entrenched posts along the line. The British Higher Command in Egypt awoke to the fact that fewer Turks were resisting them than were opposing the despised Arabs. The tide had turned.

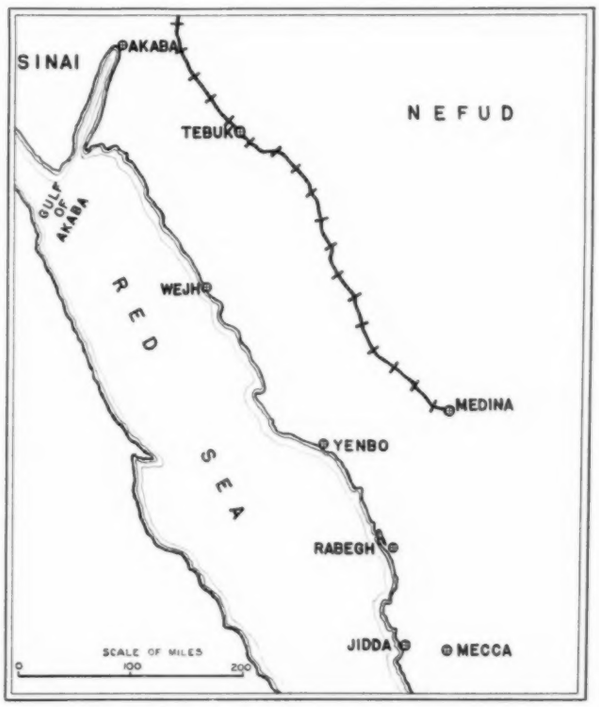
In March '17 the unaccustomed leisure of a ten days' illness gave Lawrence opportunity to go over the whole Arab War in his mind. The Arabs' aim was freedom and already the Turks were reduced to holding only a small fraction of Hejaz territory. Within that fraction—Medina and its connecting posts along the railway—the enemy were thrown back upon a passive defense which made them harmless. Moreover the Turk was richer in men than in materials, so that the Arab effort should be directed chiefly against his material resources, especially against his railway equipment. This indicated a strategy of rapid raids against the railroad line—a policy suited to the qualities and defects of the Arab levies. They would not stand casualties so that battles were out of the question, but they could move about in the desert as the Turks could not, and whenever they could derail and loot a train they would not only be hitting the enemy in his weakest point—material—but also the loot would incite still more Arabs to become rebels. Thus Medina and its railway, formidable assets to the enemy while he was advancing, would become little better than traps now that he was standing still. All this, again, chimed admirably with Lawrence's dislike and distrust for the Napoleon-Clausewitz-Foch formula of war with its inevitable and heavy sacrifices in order promptly to destroy the hostile organized forces by means of battle. Following the wiser principles of the Eighteenth Century, he preferred more economical methods. Nor should a world bankrupt from the sacrifices of 1914-1918 condemn him!

His illness over, Lawrence, still a second lieutenant, made an independent decision as bold as that of striking at Wejh. Arguing strongly against the idea of moving Feisal's force east of Wejh and putting it astride the railway, he would

move two hundred and fifty miles up the coast to Akaba. His method was as individual as his objective. The normal procedure would have been in combination with British ships, but in order to strengthen the Arab Rebellion politically, as he himself put it "to spread the infection of revolt," he would act independently, using only Arabs. The defences of Akaba faced the coast. Starting with a small party and making a vast desert circle of about six hundred miles, Lawrence succeeded in mustering some five hundred men from tribes which had not previously moved, struck the place from the land side, and took it on July 6, 1917 with a loss of only two men killed. The Turks lost over twelve hundred in killed and prisoners.

THE capture of Akaba ended the first or Hejaz phase of the Arab Revolt and began the second or Palestinian-Syrian phase which was to last for some fifteen months until the armistice with Turkey.

During that period the Arabs were to act as a mobile right wing of the British Army based upon Egypt. That army was now under a new commander. Its former chief, Sir Archibald Murray, had been relieved. Although commanding forty thousand rifles and sabers against thirteen thousand Turks, he had twice failed to take Gaza with permanent British losses of three thousand and a Turkish loss in killed and prisoners of only seventeen hundred, while the Arab irregulars under Lawrence had been killing or capturing their twelve hundred Turks with a loss of only two. The new British commander-in-chief was Allenby.



THE HEJAZ, THE ARABIAN COASTAL DISTRICT EAST OF THE RED SEA.

The strategic topography of Palestine and southern Syria is simple, consisting of four clearly defined belts of country running from north to south. The westernmost belt is the Mediterranean coastal plain, east of which is a hilly region. East of this again is the deep trench formed by the sea of Galilee, the Jordan river, the Dead Sea, and a valley connecting the south end of that Sea with the neighborhood of Akaba. Easternmost of all is a plateau extending from the Jordan-Dead Sea depression to the desert. We have likened the railroad system of Asiatic Turkey to an enormous T of which the down stroke begins as Aleppo and ends at Medina. In southern Syria and Palestine this line runs through Damascus and southward over the eastern plateau. At Deraa, about sixty-five miles south of Damascus, the crossbar of a second and smaller railroad T leaves the Hejaz line and goes westward, reaching the Mediterranean at the port of Haifa. The down stroke of this second T runs southward, first through the hill country between the Jordan valley and the coastal plain, then works down into that plain, and finally connects with the railway system of Egypt. Thus the figure formed by these various lines is as follows:

Jerusalem, in the hill country west from the north end of the Dead Sea, connects with the coastal line by a short spur.

Lawrence, remembering the Crusades and the Seventh Century Moslem invasion, stressed the importance of the East Syrian tribes and their possible use as a threat to the communications of Jerusalem. Allenby, full of offensive plans, was impressed both with Lawrence's personality and ideas. He promised support, and it was soon arranged that Feisal with his whole force should move north and base himself on Akaba.

Lawrence began to plan the use he would make of the new material resources which Allenby was to furnish him. Politically the job was to build up a new "ladder of tribes" which should reach to Damascus. Strategically the vital area in the new Arab theatre was Deraa and the Yarmuk valley leading down from that place to the Jordan, the old line of invasion from the east and the region where the first Moslem conquerors had fought their decisive battle against the East Romans, a route now doubly important because of the railway. Organization and the conduct of operations were to be developed along the former lines but on a greater scale; high mobility based upon the Arabs' skilful use of camels, especially in the desert where the Turks could not follow, while armament should suit the necessities of a rapid, widely dispersed, and decentralized war of raids and demolitions. High explosives for blasting and machine guns for combat were to be the chief weapons.

THE new Syrian phase of the Arab War opened well. The Turks prepared a counter attack to retake Akaba but were hindered and delayed by Arab tribal raiding combined with a little bombing by British planes, and when at last the enemy attacked he was bloodily repulsed. By this time the Arabs and the handful of British officers with them had become so skilful in railway demolitions that the Hejaz line was nearly paralyzed.

During the summer of '17 Allenby, now commanding some seventy-five thousand rifles and seventeen thousand sabers against thirty thousand Turkish rifles and thirteen hundred sabers, began to plan a third British attack on the Gaza-Beersheba line to take place late in October. Lawrence

and the Arabs were to coöperate by a stroke at Deraa and its railways. For this new recruits from local tribes of desert Arabs could be used. Even more important than these, because far more numerous, might be the settled Arab-speaking peasants and town dwellers whose country the rebellion was now approaching. They would rise if given the word: Deraa could be taken and even Damascus. But could these points when taken be held? That would depend on the extent of Allenby's success. If he swept all Palestine and destroyed the Turkish Army there, then all would be well both for him and the Arabs. But if his gains were less than this, then the Arabs would have to retreat, abandoning to Turkish massacre the districts whose men had risen. Such a beginning might permanently discourage the rebel sympathizers throughout Syria. Was it well, therefore, to let the settled Arabs remain quiet until next year, meanwhile using only desert men to cut the railways in aid of Allenby? Lawrence well knew the Turks to be weaker than British Headquarters supposed; he himself had gone on rash spying trips deep into their territory. On the other hand Allenby was as yet untried, and so far the British military record in Palestine had not been encouraging.

Palestine and the Trans-Jordan

Lawrence decided to postpone the general rising and to attack the Yarmuk bridges with desert Arabs alone. The fate of the British attack justified his caution, for although it gained a considerable measure of success—providing sorely needed encouragement to the entire Allied cause by taking not only Gaza and Beersheba but Jerusalem as well—it nevertheless failed to crush the Turkish Army. Accordingly the settled Arabs, had they risen, would have been sacrificed.

Meanwhile the chances of war foiled Lawrence's attempt upon the Yarmuk valley. The move had had in its favor the great distance between the objective and the Arab base at Akaba, four hundred and twenty miles by the route to be followed, so that the Turkish bridge guards would fear nothing and exercise no special vigilance, but pure chance led the Turks to send considerable detachments into the district to cut wood in the neighboring forests. Further ill luck, personal and tribal difficulties, desertion and strong suspicion of treachery, weakened the raiding force. At the last moment on the critical night, when the raiders were already under the bridge a noise alarmed the Turkish sentry, Lawrence's machine gunners were not quick enough to riddle the guard tent in time so that the guard got into action, and the Arab porters threw away the blasting gelatine for fear of being blown up themselves should a chance bullet strike it. With all hope of destroying the bridge gone, there was nothing for it but flight, and even that proved difficult. The baffled raiders had to content themselves with cutting some telegraph wires and blowing up still another train on the much enduring Hejaz line.

The winter of '17-'18 was spent in operations south and east of the Dead Sea where there was a belt of agricultural land from which the Turkish forces in Palestine drew valuable supplies of grain. Late in January at Tafileh some fifteen miles southeast from the Dead Sea Lawrence fought the skirmish which came nearest to a "pitched battle" of his military career. He afterward blamed himself, somewhat unjustly, for his decision to fight, because of the resultant loss of twenty to thirty Arabs killed, claiming that the Turks could have been beaten as effectively and more cheaply by manoeuvre. In the action he with about six hundred Arabs defeated about a thousand Turks. Skilfully using the ground, he withdrew his center and enveloped both hostile flanks, making the little action a miniature Cannae. A few days later an Arab party captured the Turkish Dead Sea grain transport flotilla by a cavalry charge against their unsuspecting crews who were sleeping on shore.

In the spring Allenby hoped to attack again and crush the Turks, but for several months most of the preliminary strokes east of the Jordan went wrong, partly through ill luck, partly through bad management, until the need to counter the considerable German successes in France took from him most of his British units.

With the early summer however the arrival of Indian troops permitted the planning of another British offensive with unlimited objectives as far as the Turkish armies in Palestine were concerned. Lawrence, visiting Headquarters to work out the Arab share in the operation, was reassured by the careful and far-reaching plans for deceiving the Turkish command. He also felt that Feisal's revolt had now reached its high point of enthusiasm from which the further stalemate would cause it to dwindle away. Accordingly now he was ready to gamble on British success by throwing the whole strength of the Arabs into cutting the three railways around Deraa. But meanwhile a Turkish force was preparing to move closer to Akaba, and if successful might hinder his intended stroke. To distract the enemy from their offensive and also from his own objective, Deraa, he proposed a far-reaching raid to be undertaken by a detachment of some three hundred of the British Camel Corps. Other British officers attached to the Arabs argued that so extensive a move by regular troops could not be adequately supplied but Lawrence carried his point. The British detachment

moved first to Akaba, thence seventy miles eastward to the Hejaz railroad, captured a fortified station, destroyed its important wells and water pumps as well as a section of line, and then moved northward through the desert east of the railway nearly two hundred miles intending to destroy a tunnel and bridge on the line near Amman. As at the Yarmuk the year before, bad luck had sent parties of Turks into the district, also a Turkish plane discovered the British on the march. Accordingly Lawrence judged the probable cost of success too high, and withdrew eastward again.

This distraction accomplished, the final stroke could be prepared. From his advanced base in the desert some sixty miles east of Amman, he proposed to continue the feint against that place by cutting the railroad north of it. Having thus temporarily prevented the Turks around Amman from reënforcing Deraa, he would cut that town's three railroads and so paralyze all the railroad communications of the Turks whom Allenby was about to attack. This attack was timed for September 19, so Lawrence had promised Allenby that he himself and his Arabs would paralyze the Deraa region on the 16th. If the British air force could bomb Deraa town heavily enough to compensate for the Arabs' lack of artillery, then the place itself could be rushed. If sufficient planes were not available, then the three railroads might be cut by circling about the town, beginning either on the north or south of the junction.

The incompetent staff officer who flew to Lawrence with Allenby's last instructions forgot to tell him either the number of planes available to bomb Deraa or Allenby's recent change of plan by which, in case of an initial success, the British commander proposed to push his cavalry in one bound fifty miles forward to Afuleh, the intersection of the smaller Turkish railroad T, i.e. the intersection of the line running southward down the coastal plain and toward Egypt with that running westward from Deraa to the Mediterranean at Haifa. Fortunately the state of the British air force was learned from the pilot who had flown the foolish officer over, so Lawrence gave up the idea of direct attack on the junction and asked merely for as many bombers as could be spared to alarm Deraa town and station in support of his encircling move.

The Arab main body of about twelve hundred would be largely increased by volunteers both from the neighboring desert tribes and the settled village Arabs. There were also British Indian and Egyptian detachments and two British armored cars. On September 14 the start was made from the Arab advanced base at Azrak. Next day the British-Egyptian and Indian detachment assigned to make the preliminary cutting of the Deraa-Amman railway came in and reported failure. They had run into a large camp of local Arabs who had been hired by the Turks to guard the line and now refused to change sides. It was an essential first stage of Lawrence's plan that this line should be at least temporarily interrupted to keep the Turks from quickly reënforcing the Deraa region from Amman. Accordingly on September 16, while the main body continued its northwestward movement toward the northern railroad, he himself with the armored cars did a hasty "snatching demolition" of a bridge about twelve miles south of Deraa. Having driven through the night, he caught up with the Arabs next morning. With only one killed they took a redoubt at Tell Arar guarding a bridge some four miles north of Deraa junction. There began an extensive demolition. When attacked by hostile airplanes coming from Deraa, the demolition parties continued work, and as they drew northward the planes neglected them for the main body which scattered so that there were only two casualties. Presently the Arabs' only plane, a feeble old thing with a brave and skilful British pilot, drew off the eight hostile planes so that three hundred and fifty Arab regulars were able to get an unobserved start for the Yarmuk line which they aimed to reach at Muzerib some eight miles west-by-south from the place where the northern railroad had been cut.

Next morning, September 17, he moved some sixteen miles southeast to the southern railroad, destroyed still another bridge—his seventy-ninth since coming to the Hejaz—and retired about five miles to the eastward to Umtaiye. Here the Arab force was again concentrated for another stroke, but meanwhile in the open desert they and their numerous animals, grouped around the only available supply, were badly exposed to air attack from planes whose aerodrome was only twelve miles off, so that the irregulars might become discouraged and go home. Presently, however, a British plane brought the great news of Allenby's splendid success, and took Lawrence back to British Headquarters to ask for further air support which was arranged. Most of the Turkish armies in front of Allenby had been destroyed and all Palestine was his, including Haifa, Afuleh Junction and the railroad eastward from Afuleh as far as the Jordan in the direction of Deraa. A few weeks before, Liman von Sandars the Turks' German commander-in-chief, fearing a big attack, had thought of retreating to a new line near the Sea of Galilee but had given up the idea because, in his own words ". . . . we would have had to give up the Hejaz railway . . . and . . . could no longer have checked the . . . . Arab insurrection in the rear of our army"—eloquent testimony to the value of Lawrence and his Arab handful.

British planes soon destroyed the Turkish air squadron at Deraa. Lawrence now made still another bold decision: to occupy Sheikh Saad, a village some sixteen miles north by west from Deraa and on the line of the Pilgrim Road, the main highway northward to Damascus. Other British officers serving with the Arabs objected that the latter would be crushed by the overwhelming numbers of the retreating Turks, but Lawrence had correctly gauged the demoralization of the enemy. Sheikh Saad was reached on the 26th and 27th, and through the following days the Arabs rendered valuable service in completing the victory. They harassed the retreat far in advance of the British cavalry. Lawrence himself, going forward by motor, was the first Englishman in Damascus.

There, at his own request, his active share in the Arab revolt ended.

SUCH was the military record of this extraordinary man who accomplished so much with means so slender. Such an outline does little justice either to his "Seven Pillars of Wisdom" as a whole or to his achievement on the personal side of command, particularly the ascendency which he gained over the Arabs. One could enlarge greatly on the justice of his military appreciations as well as the skill with which he almost continuously deceived and distracted his enemies. At least the foregoing study may help the reader to appreciate the importance of theoretical study toward the solution of unfamiliar problems when that theory has been absorbed by a powerful and flexible mind.

Ordnance of the Confederacy

Notes of Brig. Gen. Josiah Gorgas, Chief of Ordnance, C. S. A.

This is an historic document. In it the Chief of Ordnance of the Confederacy narrates many important facts not heretofore generally available.

General Gorgas' manuscript is entitled "Extracts from my notes written chiefly after the close of the war." It was forwarded by his son, the late Maj. Gen. W. C. Gorgas, then head of the Department of Sanitation, Panama Canal Zone, on April 8, 1911 to Maj. Gen. William Crozier, then Chief of Ordnance of the United States Army. In his letter of transmittal Gen. W. C. Gorgas wrote: "Please find enclosed copy of some notes of my father concerning the Ordnance Department of the Confederacy. Extracts from these notes have been used by President Jefferson Davis in his book concerning the Confederacy, and they will possibly be used elsewhere. I thought they might interest you."

It is doubtful whether there is a more valuble ordnance paper in existence. In the belief that the object lesson it teaches contains great current significance and the record it recounts great tribute to the improvization and ability of a great man and his organization, Army Ordnance *herewith presents the original manuscript. No attempt has been made to supply incomplete references in the original text.*—Editor.

Small Arms: At the formation of the Government, or at the beginning of the war, the arms at command were distributed as follows:

		Rifles	Muskets
U. S. Arsenals	At Richmond (State) about	4,000	
	Fayetteville, N. C., about	2,000	25,000
	Charleston, S. C., about	2,000	20,000
	Augusta, Ga., about	3,000	28,000
	Mt. Vernon, Ala.	2,000	20,000
	Baton Rouge, La.	2,000	27,000
		15,000	120,000

There were at Richmond about 60,000 old worthless flint muskets and at Baton Rouge about 10,000 old Hall's rifles and carbines.

Besides the foregoing there were at Little Rock, Ark., a few thousand stands, and some few at the Texas Arsenal, increasing the aggregate of serviceable arms to say 143,000. To these must be added the arms owned by the several states, and by military organizations throughout the country, giving say 150,000 in all for the use of the armies of the Confederacy. The rifles were of the calibre .54 known as Mississippi Rifles, except those at Richmond, taken from Harper's Ferry which were cal. .58; the muskets were the old flint lock, cal. .69, about 45 percussion. Of sabers there were a few boxes at each arsenal, and some short artillery swords. A few hundred holster pistols were scattered here and there. There were no revolvers.

Ammunition, Powder and Lead: There was little ammunition of any kind, or powder stored at the Arsenals in the South, and that the relics of the Mexican war, stored principally at Baton Rouge and Mt. Vernon Arsenals. I doubt whether there were a million rounds of small arm cartridges in the Confederacy. Lead there was none in store. Of powder the chief store was that captured at Norfolk; tho' there was a small quantity at each of the Southern Arsenals, say 60,000 lbs. in all, chiefly old cannon powder. The stock of percussion caps could not have exceeded one-fourth of a million.

Artillery: There were no batteries of serviceable field artillery at any of the Southern Arsenals. A few old iron guns mounted on Griboauval carriages fabricated about the time of the war of 1812 composed the entire part which the Confederate States fell heir to. There were some serviceable batteries belonging to the States, and some which belonged to volunteer companies. There were neither harness, saddles, bridles, blankets, nor other artillery or cavalry equipments.

Then to furnish 150,000 men on both sides of the Mississippi on say the 1st of May, 1861, there were on hand no infantry accoutrements, no cavalry arms or equipments, no artillery and above all no ammunition; nothing save small arms, and these almost wholly smooth were altered from flint to percussion. Let us now see what means we had for producing these supplies.

Arsenals, Workshops, Foundries, Etc. Within the limits of the Confederate States, there were no Arsenals at which any of the material of war was constructed. No Arsenal except that at Fayettevillle, N. C. had a single machine above a foot lathe. Such Arsenals as these were had been used only as depots. All the work of preparation of material had been carried on at the North; not an arm, not a gun, not a gun carriage, and except during the Mexican, scarcely a round of ammunition had, for fifty years, been prepared in the Confederate States. There were consequently no workmen, or very few of them, skilled in these arts. No powder, save perhaps for blasting, had been made at the South; and there was no saltpetre in store at any point; it was stored wholly at the North. There was no lead nor any mines of it, except on the northern limit of the Confederacy, in Virginia, and the situation of that made its product precarious. One only cannon foundry existed—at Richmond. Copper, so necessary for field artillery and for percussion caps, was just being produced in East Tennessee. There was no rolling mill for bar iron south of Richmond; and but few blast furnaces and these small and with trifling exceptions in the border states of Virginia and Tennessee.

Such were the supplies and such the situation when I took charge of the Ordnance Department on the 8th of April, 1861.

THE first thing to be attended to was the supply of powder. Large orders had been sent to the North, both by the Conf. Govt. and some of the states, and these were being rapidly

filled at the date of the attack on Fort Sumter. The entire product of one large northern mill was being received at a Southern Point. Of course all the ports were at once sealed to such importations from the North. Attention was at once turned to the production of nitre in North Alabama and in Tennessee; in the latter State under the energetic supervision of its Ordnance Department. An adequate supply of sulphur was found in New Orleans where large quantities were in store to be used in the sugar refining. The entire stock was secured, amounting to some four or five hundred tons.

The erection of a large powder mill was early pressed by President Davis and about the middle of June 1861 he decided now to detail an officer to select a site and begin the work. The day after this direction was given Col. G. W. Rains, a graduate of West Point, every way qualified for this service arrived in Richmond through the blockade, and at once set out under written instructions from me to carry out the President's wishes. He, however, went first to East Tennessee to supervise and systematize the operations of two small private mills which were then at work for the State of Tennessee.

Thus in respect of powder and our means of making it, we had perhaps at this time (June 1, 1861) 250,000 lbs. chiefly cannon, at Norfolk and in Georgia, and as much more of nitre (chiefly imported by the State of Georgia). We had no powder mills, except the two rude ones past referred to, and no experience in making powder, or in getting nitre. All had to be learned.

As to a further supply of arms, ships had been taken by the President to import these, and other Ordnance stores from Europe; and Maj. Caleb Huse, graduate of West Point and at that moment Professor in the University of Alabama, was selected to go abroad and procure them. He left Montgomery under instruction from me early in April, with a credit of £10000 (+) from Mr. Memminger. The appointment proved a happy one for he succeeded, with very little money, in buying a good supply, and in running my department in debt for nearly half a million sterling, the very best proof of his fitness for his place, and of a financial ability which supplemented the narrowness of Mr. Memminger's purse.

Before this, and immediately upon the formation of the Confederate Government, Admiral Semms had been sent to the North as purchasing agent of arms and other Ordnance stores; and succeeded in making contracts for and purchases of powder, percussion caps, cap machinery (never delivered), revolvers, &c. He also procured drawings for a bullet pressing machine and other valuable information.

The sets of machinery for making the rifle with sword bayonet and the rifle musket model of 1855 had been seized at Harper's Ferry, by the State of Virginia. That for the rifle musket was being transferred by the State to her ancient Armory at Richmond, under the direction of Lieutenant Colonel Benton, an officer in the service of Virginia whose experience in the Armories of the U. S., and in the erection of the works at Enfield, near London, qualified him above all for this work. The other set of machines was sent to Fayetteville, N. C. by consent of the State of Virginia to be there re-erected, as there was at that point an Arsenal, with steam power, and some good buildings, which had heretofore never been put to any use. These two sets of machinery, capable if worked with but one set of hands to each, of producing 2000 to 2500 stands per month in all, were the only prospective resources at home. With additional workmen and some extension of the machinery much larger results could be obtained. But the workmen were not to be had. At it was it would take many months to put it in working order. Parts were missing, and some injury done in the hasty transfer (partly under fire) from Harper's Ferry. There were no private Armories at the South nor was there any inducement, prior to the war, to turn capital in that direction. Then the class of skilled operatives needed were unknown to this region. In New Orleans the Brothers Cook were embarking in the business of making small arms assisted by the purses and encouraged by the sympathy of patriotic citizens. The older brother Frederick was a most competent mechanic, and a man of decided administrative ability. He was almost the only one who succeeded in producing a good service arm. He was finally killed in the trenches at Savannah, fighting with a command composed of his own operatives.

In *field artillery* the production was confined almost entirely to the Tredegar works in Richmond. Some castings were made in New Orleans, and founders were rapidly acquiring the necessary experience to produce good bronze cartridges. The Ordnance department of Tennessee was also turning its attention to the manufacture of field and siege artillery at Nashville. At Rome, Ga. a foundry, Noble & Son, was induced to undertake the casting of a 3-in. war rifle, after drawings furnished at Montgomery; but the progress made was very slow. The state of Virginia possessed a number of old 4-pdr. war guns which were reamed out to get a good bore, and were rifled with 3 grooves after the manner of Parrott. The army in observation at Harper's Ferry, and that at Manassas, were supplied with old batteries of 6-pdr. guns and 12-pdr. howitzers. A few Parrott guns purchased by the State of Virginia were with Magruder at Big Bethel.

For the amount of equipment required for the infantry and artillery a good laboratory had been established at Richmond by the State, but none of the Southern Arsenals were yet in a condition to do much work. The Arsenal at Augusta, Ga. was directed to organize for the preparation of ammunition, and making of knapsacks, of which there were none wherewith to equip the troops now daily taking the field. The Arsenal at Charleston and the Depot at Savannah were occupied chiefly with local work. The Arsenal at Baton Rouge was rapidly getting under way; and that at Mt. Vernon, Ala. was also being prepared for work. None of these had had facilities for the work usually done at an Arsenal. Fayetteville, N. C. was in the hands of that State, and was occupied chiefly in repairing some arms, and making up a small amount of small arms ammunition. Little artillery ammunition was being made up except for local purposes, save at Richmond. Such was the general condition of supplies when the government, quitting Montgomery, established itself at Richmond.

PROGRESS OF MANUFACTURE: Col. Rains in the course of the summer of 1861, established a refinery of saltpetre at or near Nashville, and to this point chiefly was sent the nitre obtained from the State of Georgia and that derived from caves in East and Middle Tennessee. He supplied the two powder mills in that State with nitre properly refined, and good powder was thus produced. A small portion of the Georgia nitre was sent to two small mills in S. C.—at Pendleton and

Walhalla and powder produced inferior at first but afterward improved. The State of North Carolina established a mill near Raleigh under contract with certain parties to whom the State was to furnish the nitre, of which a great part was derived from caves in Georgia. A stamping mill was also put up near New Orleans and powder produced before the fall of the city. Small quantities of powder were also received through the blockade from Wilmington to Galveston, some of it of very inferior quality. The great quantity of artillery placed in position from the Potomac to the Rio Grande required a vast supply of powder (there was no immediate want of projectiles) to furnish even the scant allowance of 50 rounds to each gun. I think we may safely estimate that on the 1st of June 1862 there were 1500 seacoast guns of various calibres in position from Evansport on the Potomac to Fort Brown on the Rio Grande. If we average their calibre at 32 pdr. and the charge of 5 lbs., it will at 40 rds. per gun give us 600,000 lbs. of powder for these. The field artillery, say 300 guns with 200 rds. to the piece would require say 125,000 and the small arm cartridges say 10,000,000 would consume 125,000 lbs. more making in all 850,000 lbs. If we deduct the 250,000 lbs. supposed to be on hand in various shapes at the beginning of the war, we have an increment of 600,000 lbs. for the year 1861. Of this perhaps 200,000 lbs. had been made at the Tennessee and other mills, leaving 400,000 to have been supplied through the blockade before the beginning of hostilities.

1861. The Site of the Government Powder Mills was fixed at Augusta, Ga. on the report of Col. Rains and progress was made on the work in this year. There were two large buildings, in the Norman (castellated) style of architecture. One contained the refinery and store rooms; the other being the mills, 12 in number. They were arranged in the best way on the canal which supplies water power to Augusta. This canal served as the means of transport for the material from point to point of its manufacture, though the mills were driven by steam. All the machinery including the very heavy rollers, was made in the Confederate states. The various qualities of powder, purchased, captured and produced were sources of irregularity in the ranges of our Artillery and small arms, unavoidably so of course. We were only too glad to take any sort of powder; and we bought some brought into Florida, the best range of which scarcely exceeded 160 yds. with the e—

Contracts were made abroad for the delivery of *nitre* through the blockade, and for producing it at home from caves. The amount delivered by contractors of the latter kind, was considerable chiefly in Tennessee.

The consumption of lead was in part met by the Virginia lead mines (Wytheville) the yield from which was from 100,000 lbs. to 150,000 lbs. per month. A laboratory for the smelting of other ores:—those from the Silver Hill mines, N. C. and from Jonesboro, East Tennessee, was put up at Petersburg, under the direction of Dr. Piggott, of Baltimore. It was very well constructed, was capable of smelting a good many thousand pounds per day, and was in operation before midsummer of 1862. Mines were opened on account of the Government in East Tennessee near the State line of Virginia. They were never valuable and were soon abandoned. Lead was collected in considerable quantities throughout the country, by laborious exertion of agents employed for this purpose. The battle field of Bull Run was fully gleaned and much lead collected.

By the close of 1861 the following Arsenals and Depots were at work, having been supplied with some machinery and facilities, and were producing the various munitions and equipments required: Augusta, Ga.—Charleston, S. C.—Fayetteville, N. C.—Richmond, Va.—Savannah, Ga.—Nashville, Tenn.—Memphis, Tenn.—Mt. Vernon, Ala.—Baton Rouge, La.—Montgomery, Ala.—Little Rock, Ark.—and San Antonio, Texas, altogether 8 arsenals and 4 depots. It would, of course, have been better, had that been practicable to have condensed our work, and to have had fewer places of manufacture; but the country was deficient in the transportation which would have been required to place the raw material at a few arsenals. In this way only could we avail ourselves of local resources, both labor and material. Thus by the close of 1861 a good deal had been done in the way of organization to produce the material of war needed by an army as far as our means permitted. But our troops were still very poorly armed and equipped. The old smooth-bore musket was still the principal weapon of the infantry; the artillery had the 6-pdr. gun and 12 pdr. —, chiefly; and the cavalry were armed with anything they could get, sabres, horse pistols, revolvers, Sharp's carbines, musketoons, short Enfield rifles, Hall's carbines (a wretched apology) muskets cut off, etc. etc. Equipments were in many cases made of stout domestic stitched in triple folds and covered with paint or rubber varnish.

But poor as were our arms, we had enough of these to arm the troops which were pressing to the front in July and August, 1861. In the winter 61-2 while McClellan was preparing his great army near Alexandria we resorted to the making of *pikes* for the infantry, and of lances for the cavalry, and many thousands of the former were made at the various arsenals, but were little used. No access of enthusiasm could induce our people to rush to the field armed with *pikes*. I remember a formidable looking weapon, which was invented at the time, in the shape of a stout wooden sheath, containing a two-edged straight sword some two feet long. The sheath or truncheon could be leveled, and the sword liberated by touching a trigger leaped out with sufficient force to transfix an opponent.

About December '61, arms began to come in through the purchase of Major Huse and we had a good many Enfield rifles in the hands of our troops at Shiloh, which were received in time for use there, through the blockade. Major Huse had found the market pretty well cleared of arms by the late war in Europe, but he had succeeded in making contracts with private manufacturers, of which these arms were the result.

I will not attempt to *trace* the development of our work in its order, as I at first intended, I remember too imperfectly for that, but will note simply what I can recollect, paying some attention to the succession of events.

THE winter of 61 and 62 was the darkest period of my department. Powder was called for on every hand: Bragg at Pensacola for his big 10-inch Columbiads; Lovell at New Orleans for his extended defenses and especially for his inadequate artillery at Forts Jackson and St. Philip; Polk at Columbus, Ky.; Johnson for his numerous batteries on the Potomac; Magruder for Yorktown. All these were deemed most important points. Then came Wilmington, Georgetown, Port Royal, and even Fernandina. Not a few of these sent representatives to press their claims, Mr. Gulie from

Fernandina and Colonel Gonzales from Charleston. Heavy guns, too, were called for in all directions, the biggest guns for the smallest places.

The abandonment of the line of the Potomac, and of the upper Mississippi from Columbus to Memphis, the evacuation of the works below Pensacola, and of Yorktown somewhat relieved us from the pressure for heavy artillery; and after the powder mills at Augusta went into operation in the fall of '62, we had little trouble to supply ammunition.

To obtain the iron needed for cannon and projectiles it became necessary to stimulate its production in Virginia, North Carolina, Tennessee, Georgia and Alabama. To this end contracts were made with iron makers in these states on liberal terms, and advances of money made to them to be refunded in products. These contracts were difficult to arrange as so much had to be done for the contractor. He must have details from the Army and the privilege of transport of provision and other supplies over the railroads. And then the question of the currency was a continually recurring problem. Mr. Benjamin, who succeeded Mr. Walker in the War department gave me great assistance in the matter of making contracts; and seemed quite at home in arranging their details. His power of work was amazing to me; and he appeared as fresh at 12 o'clock at night after a hard day's work as he had been at 9 o'clock in the morning.

About May 1862 finding that the production of nitre and iron must be systematically housed and to this end thoroughly organized, I sought for the right person to place in charge of this vital duty. My choice fell upon St. John (afterward Confederate General of Subsistence), and was immensely fortunate. He had the gift of organization and I placed him in charge of the whole subject of producing nitre from caves and other sources; and of the formation of nitre beds, which had already been begun at Richmond. Under his supervision beds were instituted at Columbia, S. C., Charleston, Savannah, Augusta, Mobile, Selma and various other points. We never extracted nitre from these beds, except for trial, but they were carefully attended to, enriched and extended and were becoming quite valuable. At the close of 1864 we had, according to Gen. St. John, 2,800,000 cubic feet of earth collected and in various stages of nitrification, of which a large proportion was prepared to yield 1-½ lbs. of nitre per foot of earth, including all the nitre beds from Richmond to Florida.

Through Major St. John the whole nitre-bearing area of the country was laid off into districts; each district in charge of an officer, who made his monthly reports to the office at Richmond. These officers got details of workmen generally from those subject to militia duty in the mountains beyond where disaffection existed, and carried on extended works in their several districts. In this way we brought up the nitre production, in the course of a year to something like half our total consumption of nitre. It was a rude, wild sort of service, and the officers in charge of these districts, especially in East Tennessee, North Carolina and North Alabama, had to show much firmness in their dealings with the turbulent people among whom, and by whose aid they worked.

It is a curious fact that the district on which we could rely for the most constant yield of nitre, having its headquarters at Greensboro, N. C., had no nitre caves in it. The nitre was produced by the lixiviation of nitrous earth, dug from under old houses, barns, etc.

The nitre production thus organized, there was added to the Nitre Bureau the duty of supervising the production of iron, lead, copper and in fine, all the minerals which needed development, including the making of sulphuric and nitric acids; which latter we had to manufacture to insure a supply of fulminate of mercury for our percussion caps. To give an idea of the extent of the duty thus performed, Lieutenant Colonel Morton, Chief of the Nitre and Mining Bureau, after the transfer of General St. John writes: "We were aiding and managing some 20 to 30 furnaces with an annual yield of 50,000 tons or more of pig metal. We had erected lead and copper smelting furnaces (a laboratory before referred to) with a capacity sufficient for all our wants, and had succeeded in smelting zinc of good quality at the same place. The chemical works were placed at Charlotte, N. C., where a pretty large leaden chamber for sulphuric acid was put up. Our chief supply of chemicals continued to come, however, from abroad, through the blockade and these works, as well as our nitraries were as much preparation against a day when the blockade might seal all foreign supply, as for the present use. These constituted our reserves for final conflict."

We had not omitted to have a pretty thorough though general exploration of the mountain regions from Virginia to Alabama, with the hope of finding deposits of lead. One of the earliest of these was made by Dr. Maupin of the University of Virginia. No favorable results came of it. I remember an anecdote he told touching one of his researches. An old settler showed the doctor a small lump of lead which he had extracted from ore like some he had in his possession. There was the lead and here was the ore, but it was not an ore of lead. The doctor cross-examined: "Did he smelt it himself?" "Yes." "What in?" "An iron ladle," such as is used for running lead balls. "Was there nothing in the ladle but this sort of ore?" "No, nothing." "Nothing at all—no addition—no flux?" "No, nothing but a little handful of common shot, thrown in to make it melt more easy!"

Much of the nitre region was close to the lines of the enemy, and here and there along its great extent, became debatable ground. Not seldom the whole working had to be suddenly withdrawn on the approach of the enemy, the "plant" hurried off, to be again returned and work resumed when the enemy had retired. Much of the work too, lay in 'Union' districts where our cause was unpopular, and where obstacles of all kinds had to be encountered and overcome. It was no holiday duty, this nitre digging, although the service was a good deal decried, by such as knew nothing of its nature.

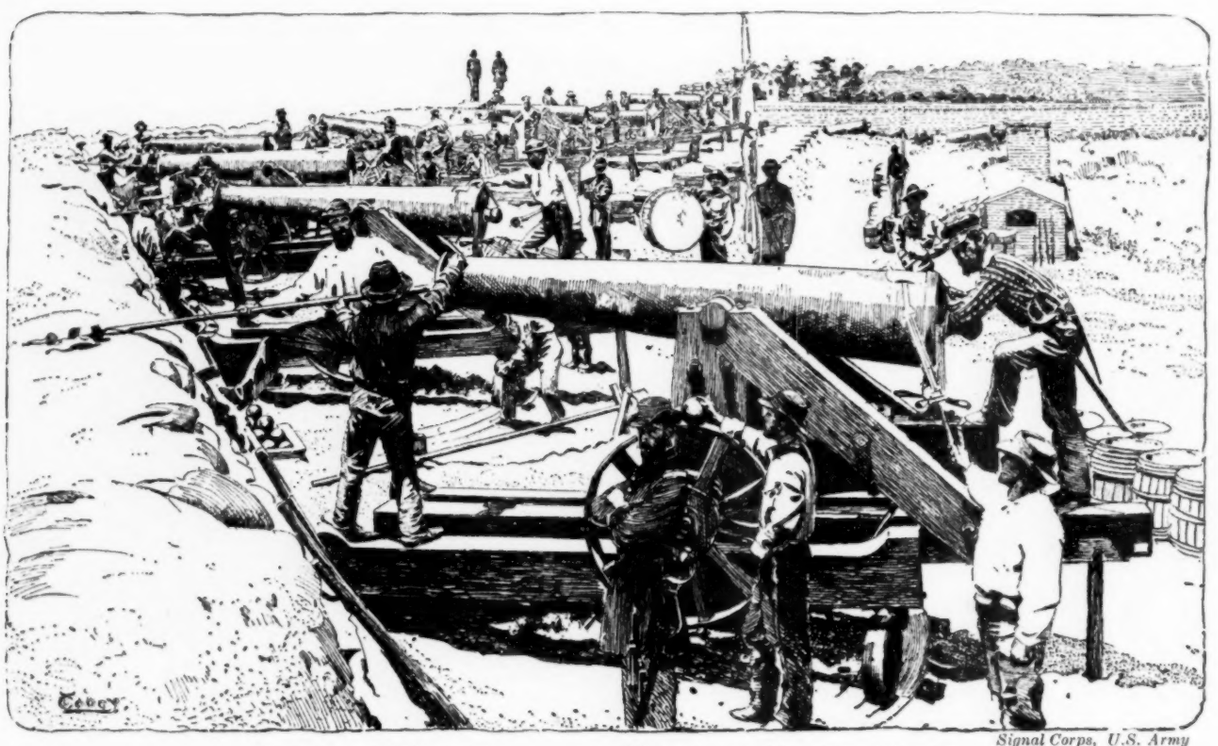
MANUFACTURE OF INFANTRY, ARTILLERY AND CAVALRY EQUIPMENTS: In equipping the armies first sent into the field the supply of these accessories was amazingly scant; and these deficiencies now felt more keenly perhaps than the more important want of arms. We had arms for over 100,000 men, such as they were, but we had no accoutrements, nor equipments; and these had to be extemporized in great measure. In time knapsacks were little thought of by the troops; and we at last contented ourselves with supplying haversacks, which the women (Heaven reward their labors) could make, and for which we could get cotton cloth. But cartridge boxes we *must* have; and as leather was also needed for artillery harness and for cavalry saddles, we had to divide the stock of leather which the country could produce

among these much needed articles. But soldiers' shoes were even more needed than even some of these; so that as all could not be fully supplied a scale of preference was established. Shoes and cartridge boxes had preference, after these artillery harness, and then saddles and bridles. The President, whose practical sagacity was rarely at fault, early reduced these interests to logical sequences. He said "For the infantry, men must first be fed, next armed, and even clothing must follow these; for if they are fed and have arms and ammunition they can fight." Thus the Subsistence Department had in a general way, a preference for its requisition on the Treasury; my Department came next, and the Quartermaster followed. Of course the Medical Department had in some things the lead of all, for its duties referred to the men themselves, and it was necessary first of all to keep the hospitals empty and the ranks full.

TO economize leather the cartridge box and waist belts were made of prepared cotton cloth stitched in three or four thicknesses. Bridle reins were also made, and even cartridge boxes covered with it, except the flap. Saddle skirts, too, were sometimes made in this way, heavily stitched. An ardent admirer of the South even came over from Washington to offer his patent for making soldiers shoes with no leather except the sole. The shoes were approved by all except those who wore them. The soldiers exchanged them with the first prostrate enemy who no longer needed his leather articles. To get leather each Department procured its own hides, made contracts with the tanner, procured hands for him by exemptions from the army, got transportation over the railroad for the hides and for supplies and finally assisted the tanner to procure food for his hands and other supplies for his tannery. One can readily see from this instance how the labors of the heads of departments became extended. Nothing but thorough organization could accomplish these multiplied and varied duties. We even established a fishery on the Cape Fear River to get oil for mechanical purposes; getting from the . . . *beef* at the same time for our workmen.

In cavalry equipments the main thing was to get a good saddle; one that did not ruin the back of the horse, for that and not the rider's seat is the point to be achieved. The rider soon accommodates himself to the seat provided for him. Not so the animal's back which suffers from a bad saddle. We adopted Jenifer's tree, which did very well while the horses were in good condition; and was praised by that prince of cavalrymen, Gen. J. E. B. Stuart. But it came down on the horse's backbone and withers as soon as the cushion of fat and muscle dwindled. The McClellan tree did better on the whole, and we finally succeeded in making a pretty good saddle of that kind; comfortable enough, but not as durable as the Federal article. In this branch of the service one of the most difficult wants to supply was the horse shoe, for Cavalry and Artillery. The want of iron and of labor both were felt. Of course, such a thing as a horse-shoe machine, to turn out thousands an hour, was not to be dreamed of, besides we would have had little store of iron wherewith to feed it. Nor could we set up machinery without much provision; for to concentrate all work on one machine referred the transportation of the iron to one point, and the distribution of the shoes from it to all the armies. But the railroads were greatly overtasked, and we were compelled to consider this point. Thus we were led to employ every way-side blacksmith shop accessible, especially those out near the theatre of operations. These again had to be looked after, supplied with material, and exempted from service.

[*Part II (Conclusion) of this article will be published in the next issue.*]



Signal Corps, U.S. Army

CONFEDERATE WATER BATTERY, NEAR WARRINGTON, PENSACOLA HARBOR

Oil and National Defense

Some Aspects of Petroleum Shortage in the United States

By B. T. Brooks and L. C. Snider*

DISCUSSION of any matter so vital to the nation's welfare, as well as its security, as our petroleum supply should not be warped or stifled because some fear the political effect of such discussion, or because minor special interests may be adversely affected.

The importance of petroleum to our Army and Navy as well as our mercantile marine and industry in time of war need not be proved to officers familiar with the uses of petroleum during the World War. The importance of petroleum both to national security and industry have grown since that time.

A few months ago Sir John Cadman briefly reviewed the period 1911 to 1935 and the following quotations are of interest:

"1911. On Mr. Winston Churchill's arrival at the Admiralty, as first Lord:— '. . . To build any large additional number of oil burning ships meant basing our naval supremacy upon oil. . . . To change the foundation of the Navy from British coal to foreign oil was a formidable decision in itself. . . . The fateful plunge was taken when it was decided to create the Fast Division. . . . The supreme ships of the Navy, on which our life depended, were fed by oil and could only be fed by oil.'

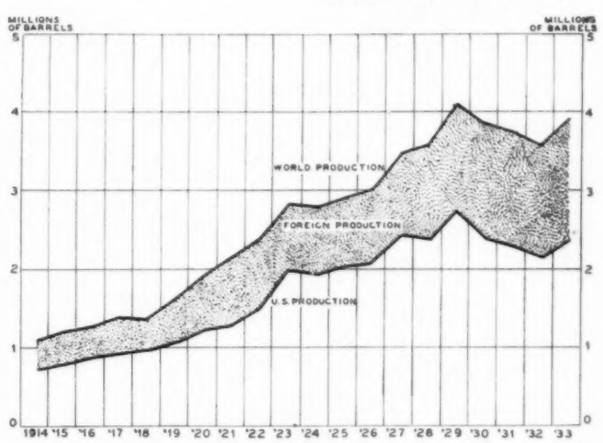
"Oil produced in Persia came on the market. During the first year the output was about 40,000 tons. (The British government became a partner in the Anglo-Persian Oil Co.)

"1917. The Admiralty demands for fuel oil had, by 1917, jumped from 130,000 tons to 330,000 tons per month. . . . In October 1918 the monthly consumption was nearly half a million tons.

"1920. World petroleum production—94,252,000 tons; tonnage of oil-burning steamers—9,359,000 tons; tonnage of motor ships—956,000 tons; aviation miles flown in regular services—2,969,000.

"The President of the Tide Water Oil Co. asserted his belief that 'kind Providence never limits the supply of anything so valuable as petroleum.'

"1925. World petroleum production—146,268,000 tons; tonnage of oil-burning steamers—17,804,000 tons; tonnage of motor ships—2,714,000 tons; aviation miles flown in regular services—13,011,00.



INCREASING PETROLEUM PRODUCTION OUTSIDE THE UNITED STATES

"1927. Oil was struck in Iraq in October.

"1933. 'Not a pool opened in the United States last year (1933) averaged 10,000 barrels a day for the year.'

"1934. World petroleum production—208,556,000 tons; tonnage of oil burning steamers—19,858,000 tons; tonnage of motor ships—10,605,000 tons; aviation miles flown in regular service—100,580,000."

LAST year (1934) in hearings before a Congressional subcommittee (on H. R. 441) the United States Geological Survey stated of this post-war period, "The diplomatic procedure of other nations, even our allies, in acquiring foreign petroleum reserves to the secretly arranged exclusion of our nationals was not without effect on the companies as well as the administration."

In December 1924 President Coolidge appointed the Federal Oil Conservation Board. The fear of our future oil supplies which actuated the appointment of this board has largely been dissipated during the intervening ten years by the discovery of a series of new producing fields of record-breaking magnitude.

It is also a fact that every estimate of our total possible future production of crude petroleum, in the United States, made by qualified authorities up to the year 1925 has been exceeded by actual production, in addition to which we have a known future reserve of ten to twelve billion barrels. These estimates were as follows:

TABLE I

Year	Authority	Estimated Reserve (billion bbls.)	Interim Production (billion bbls.)
1914	Ralph Arnold	5.7	13.7
1915	U. S. Geological Survey	7.6	13.3
1918	David White	6.7	12.5
1921	Geologists of A. A. P. G.	9.15	11.3
1925	Comm. of Eleven A. P. I.*	5.3	8.88

*An estimate based upon producing and proved acreage. No estimate was made for unproven territory.

These facts have tended to discredit the professional opinions of petroleum geologists and have created an entirely unfounded and unscientific widespread belief that oil would continue to be "found" in abundance in the United States. However, many more facts are known today than when the earlier estimates were made. Today, with wells down to 12,000 feet, drilling in all but a few localities has been carried to the lowest possible producing strata and in many cases to the bottom of the sedimentary rocks. The very rapid rate of

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discovery of new pools in the years 1925-30 was due chiefly to the rapid application of deep well technique, to more rapid drilling, and exploitation of fields when discovered and to the rapid increase in the application of geological study and geophysical methods of locating favorable structures which was particularly marked after 1924.

A TEXAS GUSHER

The statement of our reserves in terms of years' supply, such as ten or twelve years, is highly misleading as indicating that no concern need be felt until near the end of that period, whereas we shall need a new supply of considerable magnitude in about five years, no matter whether our proven reserves are *equivalent* to ten or fifteen years' supply. Though we may experience a *shortage* or an inadequate supply in five to eight years, we shall certainly not see *exhaustion* of our oil fields in fifty years. This error, in stating our reserve in terms of years' supply, is so common that it is perhaps worth while to point out that the profitably productive life of an oil field may be fifty years, or more, as in the case of Pennsylvania, New York and Ohio. New York attained its peak production in its initial year, 1882; and in 1933 was still yielding about 0.3 per cent of our domestic production. The same thing is shown in another way, i.e. less than two per cent of the wells produce fifty per cent of our oil, the two per cent being wells in recently discovered fields.[1] The oldest fields are still yielding small quantities of oil. Though our known reserve may be *equivalent* to twelve years' consumption, there is no method now known by which this oil can be brought above the ground in twelve years, no matter what its value.

According to Wallace Pratt, the known reserves of petroleum producible by known methods, are located as follows: Oklahoma, 1,000,000,000 bbls.; California, 3,500,000,000; Texas, 3,500,000,000; all others, 2,000,000,000.

According to V. R. Garfias[2] and the U. S. Geological Survey[3] our proven petroleum reserves may be as much as 13 billion barrels. A study, recently made by a well known investment company, of the oil reserves held by all important producing companies gives us a total proven reserve of 12 billion barrels. If we are not to deplete our present known reserve, it will require the discovery of about one billion barrels of new oil each year. Over the last four years, our estimated average rate of discovery has been only five hundred and eighty million barrels per year, and the recovery of part of this depends on prices being higher than at present.

IT has been pointed out recently by Wallace Pratt,[4] Chief Geologist of the Humble Oil Co., that "the rate of discovery curve climbs gradually to a conspicuous maximum in the period 1926-1930 and then slumps off sharply to a point lower than it has been for nearly twenty years. . . . The slump following 1930 is a reflection of the failure of finding technique, in spite of all efforts and all improvements, to cope with the task of maintaining the established discovery rate in the face of the ever smaller number and the greater obscurity of the pools remaining to be discovered. Even the recent remarkable progress in deeper drilling has not been sufficient to overcome the difficulty."

Our increased efficiency in finding oil in the old productive areas in the period 1925-1930 may possibly be interpreted as meaning that there is just that much less remaining to be discovered.

James McIntyre[5] has pointed out that since the discovery of the East Texas Field in the fall of 1930 to the end of June 1935, 73,000 wells have been drilled. The only field of major importance discovered during this period was Conroe in 1931.

Only three states, Arkansas, New Mexico and Montana, have been added to the list of productive states in more than twenty-five years, and neither the present production nor the proven reserve of these states is important from the national standpoint. The only important areas that have been added in the older producing states are the Panhandle (Texas) and the west Texas-southeast New Mexico district. Fields which would double the combined present production of Indiana, Illinois, Kentucky, Ohio, West Virginia, and Montana would be negligible from the national standpoint and the combined increase would not equal the normal decline in one or two years of a single flush field in Texas or Oklahoma. Most of these areas as well as less important districts have been thoroughly explored to the deepest producing sand and often to the bottom of the sedimentary rock section. By geophysical methods together with the more complete geological knowledge gained by core drilling and in other ways, the complete exploration of an area is now much more rapid than was the case a few years ago. The much faster drilling by modern methods has also contributed to the increased production of recent years.

Notwithstanding the aid of geophysical methods and extensive wild catting, no market-breaking fields and very few of major importance have been discovered since East Texas in 1930 and Conroe in 1931. (A field of major importance may be considered to be one capable of producing a total of

1. Petroleum Facts and Figures, published by the Am. Petroleum Inst., New York, Ed. 2, 1929, p. 93.

2. *Petroleum Times*, 33, 346, (1935).
3. Petroleum Investigations: Hearings Subcomm. H. R. 441, 73rd Congress.
4. Pratt, Wallace; *Oil and Gas Journal*, Sept. 5, 1935.
5. McIntyre, James; *Oil and Gas Journal*, July 25, 1935.

about 75,000,000 barrels of oil, which is about one month's supply for the United States.) With the exception of the Yates (Texas) pool no really important shallow field has been found since the A. P. I. Committee of Eleven report was issued in 1925.

Geological study has been very active. In the Gulf Coast Area in 1934, the list of geophysical activities included 60 seismographs, 40 torsion balance parties operating 117 instruments and eleven other parties using magnetometers, etc. The thoroughness with which this area had already been worked out for shallow fields is indicated by the fact that in the fields which were four years old or less at the end of 1933 the top of the producing horizon was less than 3,000 feet in only one field, and deeper than 3,000 feet in 15 fields. In the six 1934 discoveries the depth was 5,000 feet in one, 6,000 feet in one and below 7,000 feet in four.

DURING the years 1925 to 1933 the excess of domestic production over domestic consumption averaged about 75,000,000 barrels per year. This excess would have been wiped out, in the absence of important new discoveries, by two years' normal decline in only one or two of the flush fields, as shown by the following:

(1) The combined annual production of the Santa Fe Springs and Long Beach fields declined 82,000,000 barrels in two years, 1929-1931.

(2) The Seminole (Oklahoma) district declined 95,000,000 barrels in four years, 1927-1931, in spite of the discovery of new pools in the area.

(3) The four principal fields in the West Texas area declined 87,000,000 barrels from their combined peak productions (1926-1930) in 1933.

(4) The five principal pools in the East-Central Texas district (Mexia, Powell, Richland, Currie and Wortham) declined from a combined peak production of 88,000,000 barrels (1922-1925) to 7,500,000 barrels in 1928, and less than 2,000,000 barrels in 1933.

Objection may be raised to the significance of the last item above, on account of proration and restricted production. The official "potential" figures, upon which proration is based, have given an entirely false impression of the actual production capability of many fields. "Potentials" are based upon the flow for short periods, from a few minutes to a day or two, of individual wells, or of "key" wells upon which the potentials of larger groups of wells are based. The absurdity of the exaggerated potential production of the East Texas field is shown by the fact that a late official determination gave this field an hourly potential of 10,000,000 barrels. At this rate, 240 million barrels per day, the total amount of producible oil estimated to be *remaining* in this field, would be produced in about one week.

The maximum rate of production which will give the greatest ultimate recovery at the lowest cost, called the *critical production,* is also usually far below the official "potential." For example, the Yates (Texas) field was given an official potential production (March 1931) of 5,508,000 barrels per day. It was found, however, that the flow had to be kept below about 100,000 barrels per day to prevent many of the wells from going to water. The umpire of the field estimated that the field could produce 3½ million barrels in one day by unrestricted flow, but that 98 per cent of the wells would be showing water and that in 30 days the field could produce not more than 10,000 barrels per day.

The Hobbs (New Mexico) field has a daily "potential" of more than 2,000,000 barrels with an "allowable" production of 33,000 barrels per day. On acount of water difficulties this allowable production could not be greatly increased without doing great damage to the field.

Restricted fields similar to Hobbs, Yates and Van, in which

HOW NEAR DRY?

drilling has been controlled, promise to give a dependable back log of production at somewhere near their "critical" rate for several years to come. Although many of the more recently developed fields could have produced for short periods at rates greatly in excess of the rates attained, they would probably have been quickly depleted or ruined by such unrestricted production. A general study of field histories shows that the slower drilling and slower development and the natural conditions of the older fields were as efficient in restricting their rate of production as artificial restrictions are in most of the recent rapidly drilled fields.

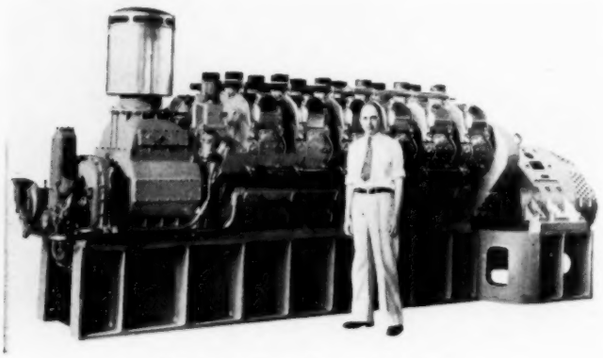
SINCE the report of the A. P. I. Committee of Eleven was published in 1925, much of the territory listed as probably productive has been condemned by drilling. The old producing areas in Kansas have now been drilled to the bottom of the sedimentary rock column. The large number of dry holes drilled in this area, 2,334 in Marion, Butler, Greenwood, and Cowly counties, condemns this area so far as important new pools are concerned.

The eastern and southern half of Oklahoma is similarly condemned for important new fields. Creek County with over 2,000 dry holes and Okmulgee and Osage counties, with more than 3,000 dry holes each, show the extent to which these areas have been tested. There literally is not room between dry holes for an important new field in these areas.

The area now being actively exploited in Kansas and

Oklahoma is a strip extending generally northward from the Arbuckle Mountains. Practically all of the new fields in Oklahoma and most of those in Kansas, are producing from the deepest possible productive horizons (Ordovician). This entire area has been thoroughly worked by surface and subsurface geological methods, closely core drilled, completely worked over with magnetometers and the Oklahoma portion completely and the Kansas area largely explored with the seismograph. At the rate at which the structures thus found are being tested it is safe to say that any pool of even moderate importance now remaining in this area will be discovered within the next year or two.

In Texas the broad central belt with the San Antonio and



A Locomotive Diesel Engine

Mexia-Powell districts on the eastern, and the Ranger-Breckenridge and Wichita Falls districts on its western margin, is now condemned by deep drilling for important new pools. The area of the Caddo or Sabine uplift, with a few small pools in Louisiana on its crest and the East Texas field on its western margin can be said to be condemned for important new production, down to the Trinity beds in which there is some, though not a great, chance for production important from a national standpoint.

It is impossible within the limits of this paper to discuss all the producing or potentially producing areas in detail. Three areas in Texas are being actively exploited, the Panhandle, West Texas and northeastern Gulf Coast districts. The Panhandle district is well worked out within the present outline of the area but deep drilling on the flanks of the uplifts may discover something of importance. Small pools are still being found along the northern margin of the West Texas area. The district was discovered in 1923 and all the more important fields were discovered by the end of 1927. Deeper drilling, into the Ordovician, has been very disappointing, yielding less than 20,000,000 barrels deep production in the Big Lake field up to the end of 1933. The Gulf Coast belt of Texas and Louisiana was thoroughly worked over for shallow production during its early history. Of the 81 separately listed fields only six have so far approached or exceeded 75 million barrels and the whole area has produced little more than a year's supply for the United States. Conroe, discovered in 1931, is the only recent field of major importance in this area. Since the discovery of Conroe, more than 300 wild cat wells drilled in this area have yielded only twelve new prospects or pools, none of which as yet promises to be as important as the better older fields. The deep sands of the Gulf Coast tend to produce gas instead of oil.

The outlines of the probably productive areas in California are drawn today practically as they were twenty years ago. Ventura Avenue in 1925 and Kettleman Hills in 1929 are the only contributions from this state in recent years which now appear to be of great importance.

DEEPER drilling has given practically no results in the old Appalachian area, where wells have been drilled to a depth 4,000 feet below the deepest known production.

The production of Michigan to the end of 1933 was 27½ million barrels, or the equivalent of about 10 days' domestic consumption. The production in 1934 was less than one per cent of the United States total.

Of the Rocky Mountain states, Wyoming is by far the most important, having produced since 1889 2.2 per cent of the United States total production, or 4½ months' supply. In the entire area of the Rocky Mountain states, years of exploration and the drilling of more than 2,500 dry holes, which have tested most of the known structures, have revealed only two important fields, Salt Creek and Hobbs.

In an earlier optimistic estimate of possibly productive territory, the states of New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Missouri, Wisconsin, Idaho and Nevada were included in whole or in part. These now deserve little or no consideration as possible contributors of any importance to our future petroleum supply.

The possibly more promising areas, from the standpoint of their geology, are the northern plains states, North Dakota, South Dakota, Nebraska and Iowa, and the eastern Gulf Coast states, Mississippi, Alabama and Florida. Of these however it can be now said that the possibly productive areas have been much more thoroughly explored and more carefully tested than was any one of the major producing states before petroleum was found in important quantities.

One indication of the approaching exhaustion of the possibility of discovering important new fields is the increasing percentage of dry holes drilled. Although our geological knowledge is much more accurate and extensive, and many more geologists are employed in finding oil than in earlier years, the proportion of dry holes drilled has increased. In Texas this percentage fluctuated moderately below 30 per cent to 1917, descended to 17 per cent in 1919 and then rose steadily to 45 per cent in 1930. In Oklahoma the dry hole percentage ranged between 7 and 20 from 1904 to 1917, between 20 and 30 from 1918 to 1924 and between 30 and 35 from 1924 to 1933. In California the percentage of dry holes varied from 3 to 12 per cent from 1905 to 1922; then from 21 to 26 per cent from 1923 to 1930; was 49 in 1931; 48 in 1932 and 40 in 1933.

THE statistical history of the industry shows that although high prices have stimulated drilling they have not resulted in the discovery of important new fields in old areas which had previously been prospected thoroughly. Thus in spite of the high crude prices during the war years the combined production of the Appalachian states was 15 million barrels less in 1920 than in 1915.

The supply of petroleum has been more effective in controlling the price than the price has been in controlling the supply; the effect of price on production has been very remote. High price levels will increase somewhat the amount of petroleum recovered in the later stages of the productive life of the fields, but will not necessarily result in the discovery of

new fields sufficient to maintain our rate of production.

Current estimates of proven reserves vary from about 10 billion to 15 billion barrels. This may seem to be a wide variation; but the difference is caused principally by different interpretation of what is proven territory. Some of the more liberal estimates evidently include some acreage of doubtful character. In addition to the proven reserve an unknown amount of oil lies in undiscovered fields. The facts presented above indicate in a very qualitative way what the chances for discovering new producing areas, or important new fields in old producing areas, are. In view of the facts, there is no assurance that the proven and unproven reserves are large enough, or that new discoveries will provide production fast enough to maintain the present position of our petroleum industry. The available evidence indicates that we will be fortunate if we can supply our own consumption at its present rate for any period longer than five years, and a shortage may develop sooner should the consumption increase. It may be repeated that we have not supplied our total demand, including exports, for many years; but have used several hundred million barrels of imported oil.

THE estimates of total oil recovery already given include that to be produced by such auxiliary methods of production as repressuring, and water flooding, where they have been shown to be practicable. Water drive is applicable to but very few fields. Even though this method is particularly favored by the conditions in the Bradford, Pa. field, and Bradford oil commands the highest price paid for oil in the United States, the effect of water flooding has only moderately increased the trickle so far as our total demand is concerned. The American Petroleum Institute Report on Supply and Demand[6] comments that "Flooding is expensive and cannot be done on low priced oil."

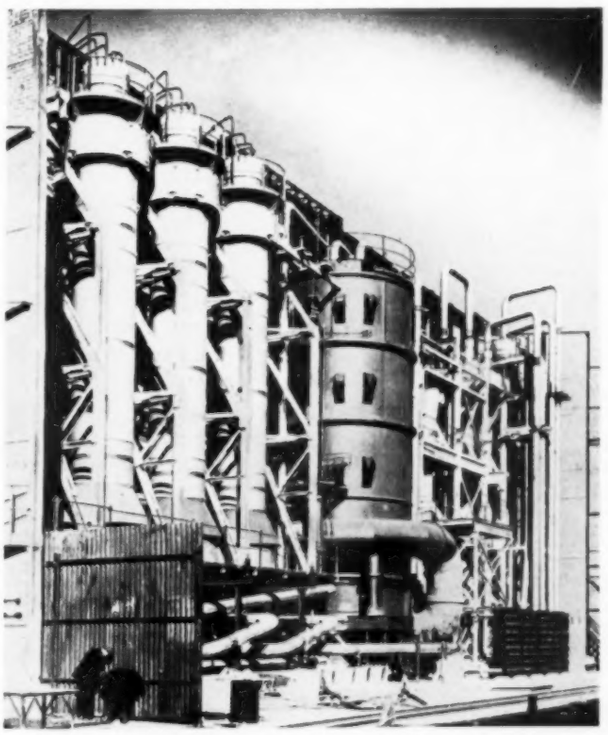
Water flooding was authorized in Pennsylvania in 1920 and the effect of this operation on this state's production was noticeable by 1925-1926. If we credit all the increase to water flooding this operation has raised Pennsylvania's production from 0.82 per cent in 1920 to 2.1 per cent of the total United States production in 1934.

Repressuring by gas, for secondary recovery, is also limited to sands of the general type of the Bradford and no attempt has been made to apply it to deep, unconsolidated, variable, water-logged sands. It was first used in Ohio about 1912 but Ohio's production has declined from 9 million barrels in that year to about 4 million in 1934.

Mining for draining or removal of old oil sand has not been attempted on a large scale in the United States. Driving tunnels in or below the sands, the method practiced at Pechelbronn, Alsace, is practically unthinkable in the unconsolidated sediments of the Gulf Coast and California. Gas given off by the oil would be a very serious if not insuperable obstacle to be handled. Actual mining of the sand has been suggested. Using data given by the A. P. I. Committee of Eleven, the average number of tons of sand required to recover a barrel of oil ranged upward from 3.2 tons in Montana. Kansas would require 13 tons; Oklahoma, 15 tons; California, 10 tons; Texas, 41 tons; Pennsylvania, 48 tons; Illinois, 38 tons, etc. These figures are not accurate but they show plainly that only exceptionally rich sands under exceptionally favorable conditions can be mined for their oil content at any remotely possible prices.

6. American Petroleum Supply and Demand. New York 1925, p. 105.

SHALE has long been regarded as guaranteeing a plentiful supply of oil in the future, or as supplementing our petroleum supply, and so it may,—*at a price*. The price ranges of petroleum in the United States have not been high enough to inspire any attempt to retort oil shale on a large commercial scale. This very fact makes it impossible to say at what price level, for crude petroleum, shale oil can begin to compete.



AN ENGLISH PLANT FOR THE PRODUCTION OF GASOLINE FROM COAL BY HYDROGENATION.

Perhaps $2.50 per barrel for average Mid-Continent crude at the well may be such a price level. For the great oil shale deposits of Colorado, Utah and Wyoming the estimates of the cost of mining vary from a low figure of 40 cents a ton for open cut methods to as high as $2.50 a ton for selected mining. According to the Bureau of Mines, the estimated average yield for a thickness of 500 feet in the famous Green River formation of Colorado is about 15 gallons per ton, selected sections running much higher.

This average yield would require the mining and processing of about 2.5 billion tons of shale per year, or more than 7 million tons per working day to supply the same amount of oil now consumed in the United States. Higher petroleum prices may stimulate the gradual development of oil shale distillation, beginning with selective mining of richer shale in favorable localities.

In the second report (1928) of the Federal Oil Conservation Board, it is stated that "an oil shale industry in the United States, to be successful, would need to be operated on an extremely large scale, possibly on a larger scale than any mining operations" and that "the small shale operator would doubtless find it practically impossible to compete with the lower costs of mining and retorting that would be realized only by large scale operation." This fact together with the close chemical resemblance of shale oil and petroleum and the existing equipment for the transportation and refining of

petroleum and distribution of its products, now possessed by the larger refining companies, makes it altogether probable that when we are ready for shale oil the petroleum refiners will produce and refine it unless the processes using coal prove to be the cheaper.

The initial investment in mining, retorting and refining equipment would be so high that the building of such plants might not be justified until after a period of several years of high prices due to petroleum shortage. Assuming the ultimate establishment of a huge oil shale industry, it is a question if this would afford any relief as to cost, or would restore all of the uses of petroleum as it is consumed today. The fact that a small shale oil industry exists in Scotland is no indication that such an industry could now successfully be established here. The shale oil industry of Scotland has survived from a period when the average yield of oil was 33 to 36 gallons per ton, and the torbanites then available gave very much higher yields. The cost of labor was then much lower, the price of petroleum was much higher than in recent years, and the shale mined much nearer the surface than now. It now costs five to six shillings per ton to mine the shale and with the best Scotch economy the crude shale oil costs 4.5 pence per gallon (British) or about $3.02 per barrel. Furthermore, the gasoline from this source is exempt from a tax of 8 pence per British gallon or 12.8 cents per U .S. gallon, which tax is paid by imported gasoline or gasoline made from imported petroleum. The shale oil manufacturers also enjoy a tax, recently imposed, on Diesel oil from foreign sources.

IT is well understood that the retorting of coal cannot produce sufficient motor fuel to be a factor in the situation. The entire tonnage of bituminous coal retorted in the United States in 1926 yielded 1.02 per cent of our motor fuel requirement in 1925. Since then gasoline consumption has increased nearly 50 per cent and our benzol production has declined. The production of benzol in 1934 was 0.37 per cent of our motor fuel output. Practically all of the coke required for metallurgical purposes is now made in by-product ovens, in which benzol recovery is the rule. Any possible increase in benzol production from the coking of coal for metallurgical purposes would be negligible from the motor fuel standpoint.

It has been suggested that our future motor fuel requirement could be produced by pressure cracking of the tar made by low temperature carbonization of coal. It is possible that up to a certain point such a process might be a factor in alleviating a shortage of motor fuel, but it should be pointed out that several attempts to carry out the low temperature distillation of coal in the United States have been industrial failures. Low temperature carbonization of coal and pressure cracking of the tar was discussed by A. C. Fieldner in a report by the U. S. Bureau of Mines to a sub-committee on petroleum of the last Congress,[7] who stated that, assuming a total yield of 10 gallons of motor fuel per ton of coal, 136 million tons of coal would have yielded only 8 per cent of our gasoline in 1932. Fieldner concluded that, "We must turn to a process in which motor fuel is the principal product rather than a by-product."

On the other hand, the trend of large scale developments in England and Germany is toward hydrogenation of coal. In the latter country coal hydrogenation yields about 80 gallons per short ton of coal. By 1936 it is reported that the German plants will be hydrogenating 2.5 million tons of coal annually, producing about 200 million gallons of gasoline in this way. In England a coal hydrogenation plant has been erected which is reported to have an annual capacity of about 55 million U. S. gallons of gasoline when operating on coal and tar, or about 70 million gallons when hydrogenating tar.

It should be particularly pointed out that in England gasoline made by hydrogenation of coal is exempt from the tax equivalent to 12.8 cents per U. S. gallon and in Germany the process is favored by a similar tax exemption of 220 marks per ton or about 24 cents per U. S. gallon. It cannot be assumed in either case that the tax differential is a measure of the difference in cost between gasoline from petroleum and from coal, since in both countries these plans are considered to be a step in the national security programs of these countries and to be maintained and developed by the indirect subsidy.

IN the United States the next step in the direction of greater gasoline yields may be the combination of hydrogenation with pressure cracking, as suggested by Russell, Gohr and Voorhees.[8] The average gasoline yield by cracking alone is about 60 per cent, and by complete hydrogenation about 108 per cent. The latter is an increase of about 80 per cent over that by pressure cracking alone. The hydrogenation of a portion of the recycle stock as suggested by Russell, Gohr and Voorhees provides an optional flexibility as to gasoline yields. As indicated by the fuel oil statistics given below there is relatively little margin for increasing our gasoline production by the installation of more cracking units. Hydrogenation provides a means of substantially increasing the gasoline yield; less cracked fuel oil would of course be produced.

The yields of gasoline from two German brown coals as the process is now operated (1935) have been given by Pier[9] as follows:

OIL YIELDS ON HYDROGENATING TWO BROWN COALS

	I per cent	II per cent
Carbon in a.m.f. coal	68	68
Bitumen in a.m.f. coal	13	8
Yields		
Gasoline	33	37
Lubricating oil	13	13
Paraffin	11	7

In Germany and England, the scale of industrial operations indicates that motor fuel is more cheaply produced by the hydrogenation of coal than by the reduction of water gas.

It will be noted in both distillation of shale and the hydrogenation of coal, several years must elapse to build them up to any magnitude. In the event of a national emergency such as war, the emergency would be settled one way or another long before any large part of our gasoline demand could be supplied from the auxiliary sources.

Another possible source of motor fuel, lubricants and wax is a modification of the synthetic methanol process. In this process, upon which work was started by the Badische Co. by F. Fischer and Patart in 1913-1914, water gas is reduced by excess hydrogen to light hydrocarbon oils. According to data recently published by Fischer,[10] 1,000 cubic feet of water gas will yield about 1.1 gallons of light hydrocarbon condensate, part of which is suitable for motor fuel. The yields are lower than in the case of synthetic methanol and the costs per gallon higher.

The lubricating oils made by Fischer are made by polymer-

7. Petroleum Investigations, loc. cit. p. 1375.

8. J. Inst. Petr. Techn. 21, 352 (1935).
9. J. S. C. I., 54, 284, (1935).
10. Brennstoff Chemie, 16, 1, (1935).

izing the unsaturated hydrocarbons in the lighter fractions, or by chlorinating and treating with metallic aluminum. These oils have the characteristics of lubricating oils of the paraffinic or Pennsylvania type. However, it should be pointed out that the lubricating oil now manufactured in the United States represents less than 3 per cent of the crude and that much more could be manufactured from our present crude supply, if it were needed. Lubricating oil has also been manufactured by the polymerization of cracked paraffin wax and other olefins, and by the hydrogenation of heavy oil residues. We could therefore manufacture an adequate supply of lubricants from a much diminished crude supply.

Shortage or surplus depends upon the rate at which petroleum can be produced, and not on the total amount in reserve, nor on the substitutes which may be available in the course of time, at some higher price level. Substitutes, such as oil from shale, the hydrogenation of coal or water gas, increased efficiency in utilization and imports will affect the stringency of a shortage, but will not prevent one.

SO far as consumption is concerned the question of an adequate supply of petroleum has primarily to do with motor fuel, 47 per cent of our crude oil consumption now going into gasoline. A shortage of domestic crude petroleum will be a great stimulus to increased efficiency in manufacture and utilization. The expected normal increase in consumption may largely be compensated by increased efficiency in utilization.

The manufacture of natural gasoline in recent years has in general followed the production of crude oil, and reached a peak in 1929. The amount of natural gasoline manufactured per barrel of crude oil produced has been nearly constant at 2 gallons, since 1926. Decreasing domestic crude production will further curtail the amount of gasoline available from this source.

During the past year processes for the manufacture of gasoline from uncondensed refinery gas and such material as ephane, propane, butane and the gaseous olefins have come into commercial operation. With the interest which always is aroused by a new process the relative importance of this gasoline as a new source of motor fuel has been somewhat exaggerated. The new production from this source partly offsets the higher gas losses occasioned by the use of higher cracking temperatures which are being employed to meet the demand for higher octane value motor fuels. The yield of uncondensed gas formed in cracking averages about 10 per cent of the original cracking stocks, of which about one third (in weight) may be recovered as motor fuel by gas "polymerization" processes. A much more important potential new source of motor fuel is the cracking and "polymerizing" of the crude propane and butane in natural gas. Of the available butane about one-fourth is now incorporated in motor fuel. According to Oberfell[11] the total amount of liquefiable petroleum gases, mostly propane, available from the natural gasoline industry amounts to between 10 million and 13 million gallons per day, of which he estimates that about 50 per cent exists at plants too small to justify its separation. By a yield of 50 per cent of liquid motor fuel by pyrolosis and polymerization the possible new production of motor fuel from this source may be as much as 985 million gallons per year or about 5.8 per cent of our present gasoline requirement.

The manufacture of polymer gasoline is important for another reason, i. e., the high antiknock value of such gasoline.

The use of higher compressions in automobile engines is always considered as in the interest of motor fuel conservation and greater engine efficiency. The average compression ratio of 18 of the leading cars in 1934 [12] was 5.83 : 1 and for the same makes of cars in 1935 the ratio was 5.99 : 1. The average octane number of the regular nonpremium grades of gasoline sold in the eastern United States in 1934 has been estimated at 69-70 and for 1935 as about 70-71. Straight run gasoline has an average octane number of about 55, the more paraffinic gasolines being as low as 45. In 1934 about 50 per cent of the gasoline made (in the United States) was straight run gasoline from crudes. Reforming or cracking such straight run gasolines, particularly those of the more paraffinic type, has become more and more imperative as the engine compression ratios are raised. The losses in the form of gas, heavier oil and tar, resulting in such reforming cracking are as high as 20 per cent. The conservation of gasoline effected by higher engine compression is therefore not all clear gain.

THE use of Diesel oil in motor cars is evidently possible. Six American firms have placed high-speed automotive Diesel engines on the market and eleven American maunfacturers of trucks are prepared to supply Diesel engines when specified. The first cost is 80 to 100 per cent higher than gasoline engines of the same displacement, for example, a 4-cylinder 90-horsepower Diesel engine being quoted by the manufacturer at $1550 and six cylinder engines considerably higher. However, if such equipment meets with popular favor Diesel oil will supplement gasoline. The use of Diesel oil in England, for automotive use, has become important enough to have had a motor fuel tax imposed upon it this year.

Since Diesel oil is included in the heavier fractions now used as cracking stocks yielding 60 to 65 per cent gasoline by cracking, and since Diesel oil gives a much greater car mileage, nearly double that of gasoline, it is apparent that the use of Diesel fuel in automotive engines will be greatly stimulated by petroleum shortage and its adoption would be helpful in alleviating the effects of a domestic oil shortage.

Under the conditions of an oil shortage, refineries with little or no production of their own, will operate, if at all, under an increasingly serious handicap. Low priced "distress" crude will be unknown. According to the survey of domestic reserves held by American companies, made recently by J. H. Lewis of Goodbody and Co., 91 per cent of our proven reserves are owned or controlled by nineteen companies. That the executives of certain companies realize the approaching situation is possibly indicated by the fact that at the end of 1934, 15 companies held in fee or under lease 30 million acres of non-productive land. A few companies have greatly increased their reserves in South American fields during recent years.

Relatively abundant foreign supplies of petroleum with a shortage of our own supply will tend to raise our prices for petroleum products in relation to prices in other countries and finally bring our prices up to or above theirs.

The relative proportions of the major refining products has continually changed through the whole history of the industry. The changes in the years 1914-1934 are shown in Table II. High price levels will certainly cause a further change, the products of lower value becoming more and more restricted with advancing prices.

11. Oberfell, G. G., Oil and Gas J., Nov. 17, 1932.

12. Willson, Oil and Gas J., *33*, No. 35, 16 (1935).

TABLE II

PRINCIPAL PRODUCTS FROM CRUDE OIL.

Year	Gasoline and Naphtha per cent	Kerosene per cent	Gas Oil and Fuel Oil per cent	Lubricants per cent
1914	18.2	24.1	46.5	6.6
1918	25.3	13.3	53.5	6.2
1920	26.1	12.7	48.6	5.7
1922	28.8	11.0	50.9	4.7
1924	31.2	9.3	49.8	4.3
1926	34.9	7.9	46.9	4.1
1928	37.4	6.6	46.7	3.8
1930	42.0	5.3	40.2	3.7
1932	44.7	5.3	35.9	2.7
1934	47.4	6.0	37.5	2.8

The industries that will be affected by higher prices and the conservation of fuel oil for cracking are indicated in the following data from the U. S. Bureau of Mines:

TABLE III

USES OF GAS OIL AND FUEL OIL IN THE U. S.
(in 1000 bbls. of 42 gallons each).

Industry	1926	1928	1931
Railroads	72,217	70,680	58,150
Steamships	79,287	89,942	83,558
Gas and electric power plants	33,651	30,901	24,490
Iron and steel products	16,102	19,429	12,855
Smelters and mines	8,941	6,897	3,626
Chemicals and allied industries	.....	3,400	2,907
Automotive industries	1,603	3,628	1,783
Textiles	.....	4,586	5,683
Paper	.....	2,792	1,833
Logging and lumber	3,183	2,673	1,667
Cement and lime	5,586	5,223	2,434
Ceramics	3,216	2,995	1,598
Foods	7,674	6,488	5,660
Other manufacturing	23,017	10,023	9,998
Commercial heating	13,874	16,427	15,731
Domestic heating	3,905	5,971	10,466
Furnace oils, domestic	6,300	8,300	14,213
Oil companies	48,701	50,044	51,196
Miscellaneous	7,514	12,757	10,266
U. S. Navy	6,541	8,368	9,203

It should be pointed out that the above figures include the fuel oil produced in cracking for gasoline. In 1934 the total domestic consumption of fuel oil was 325 million barrels, of which 178 million barrels was residual oil from cracking. The remaining uncracked fuel oil is mostly heavy oil of relatively little value as cracking stock. This shows very clearly that our supply of motor fuel can be increased very little from our present crude supply by cracking without cutting into other important established uses. As noted above, the manufacture of gasoline from heavier oil by hydrogenation eliminates the formation of residual fuel oil entirely, and the combination of cracking and hydrogenation recommended by Russell, Gohr and Voorhees decreases it substantially. In so far as these methods are applied, gasoline production may be increased at the expense of fuel oil. Without relief by importing more crude, a decrease of 12 per cent in the supply of average grade of crude would require the diversion to cracking stock of an amount of gas oil and fuel oil equal to the combined amount now used as furnace oil, by commercial and domestic heating, by the gas and electric industry plus all of the kerosene now produced. Or such a decrease in crude production, if compensated for by increased cracking, would require the diversion for cracking to gasoline, of more fuel oil than is now used by the U. S. Navy and all the steamships supplied by American fuel oil.

What would naturally happen, unless relieved by greater imports, would be a readjustment of prices all along the line. The trend shown in Table II may be expected to continue.

If the cost of gasoline becomes high enough to consider any of the substitutes already mentioned the use of small, low-powered automobiles may be favored which would reduce the gasoline requirement and would have far reaching effects on the automobile and allied industries. The effect of relatively high motor fuel costs, plus high taxes, in favoring low-powered cars has already occurred in Europe to a conspicuous degree, gasoline now retailing at 86 cents per gallon in Italy and 56 cents per gallon in Germany.

GEOLOGICAL exploration and drilling have greatly extended our knowledge of potential oil producing areas. Taking into account the proven reserves, areas condemned for important production by drilling and the increasing difficulty and decreasing rate of oil discovery, we conclude that a shortage of domestic petroleum production may be expected in five to eight years.

Increased imports from foreign fields may prevent a substantial rise in the petroleum price structure, for a few years. Insofar as we become dependent upon imported petroleum the United States will not be industrially self sustaining. The interruption of such imports in time of war would cause a serious dislocation of industry.

In a report made last year, to a subcommittee of the 73rd Congress (on H. R. 441) the United States Geological Survey stated, "It should be urged that making provision in advance against the day, certainly not long distant, when waning domestic petroleum reserves will fall shorter and still shorter of meeting American domestic needs, is not only natural and logical,—it is fundamentally sound and necessary." We agree with this conclusion.

Changes in the price structure and in the utilization of petroleum products in industry, which are due to shortage of our domestic supply will be gradual. At higher price levels for crude petroleum and its products, petroleum substitutes will begin to compete with natural petroleum. Some of these have already been manufactured in Europe, with the benefit of government subsidies or preferential taxes, on a sufficiently large scale to assure us of their practical application here. The manufacture of these petroleum substitutes would be new industries for the United States.

The cost of producing oil from our western shales or by hydrogenation of American coals is not accurately known. Crude shale oil in Scotland costs about $3.00 per barrel and motor fuel by the hydrogenation of coal costs about 16 cents per U. S. gallon to produce. These figures indicate approximately what the basic plant costs will be when ultimately we have to rely upon coal or shale for an important percentage of our supply of oil and motor fuel.

While our present petroleum reserves may postpone the necessity for the manufacture of petroleum substitutes for a few years, there is nothing alarming or pessimistic in the prospect of manufacturing motor fuel from coal.

If we are to be nationally self-sustained, the manufacture of such substitutes will have to be built up to supplement our oil supply as our domestic production declines.

The questions raised in this discussion cannot be dismissed or indefinitely put off. The next few years will show the trends more clearly.

Editor's Note—A reference to some of the implications of this study by Major Brooks and Mr. Snider is published under the editorial discussion, "Oil for the Motors of America", on page 236 of this issue.

Our Defense Needs

We Lack Reserves of Trained Officers and Modern Arms

By Brig. Gen. John Ross Delafield*

THE subject of national defense has been so much discussed that I feel myself compelled to offer some explanation before imposing at this time for its further consideration. The reason is the changed relations of the great countries of Europe and Asia.

The most important of these changes is the virtual abandonment of the League of Nations by three great powers, Italy, Germany and Japan, and some of the lesser ones. These nations have also, in effect, repudiated the so-called Kellogg Peace Pact. This action on their part is because those of the great industrial nations that most lack material resources are now compelled by economic necessity created by other nations to seek by force sources of supply and markets for their products.

The millions who live in modern civilized countries depend upon industry. If they were forced to return to the hand work of a century or two ago then at least half, perhaps three quarters, of them must starve to death. Mass production, low prices for manufactured products, new inventions, great factories crowded with employees, countless sales at small profits, are necessary to support our modern populations and to keep them fed, clothed and housed. But without raw materials, and without wide markets these conditions are impossible. This condition is ably stated by Frank H. Simonds in *The Saturday Evening Post* of October 5, 1935. It is worse than war, it is suicide for an industrial nation to lose them. It is a life or death struggle to gain them. Tariff walls and quotas have cut them off from these three great nations. Only those industrial states which themselves own such resources can in the face of these handicaps survive. Those who do not own these advantages must gain them even at the cost of war.

Tariff walls and quotas have, therefore, forced these nations to violence, to war, to gain the raw materials and the markets they need to enable their industrial populations to live, for these countries are among the most densely populated of the world.

NATURALLY the victims from whom these supplies and resources are, or will be, seized, are the weak countries who cannot defend themselves. So Japan has taken Manchuria from helpless China. Thus Japan has gained raw materials, iron, coal, grain, livestock, and the labor to produce these things necessary to large scale modern industry. Italy seeks to gain like resources by taking Ethiopia (Abyssinia) by force. Germany before the World War had let it be known she felt she did not have her "place in the sun", by which was meant that she lacked supplies and markets. Only within a few years she was prevented from taking over Austria by a mobilization of the great Italian army. This policy has already taken Japan and Germany out of the League, and it is hard to see how Italy can long remain a member.

The League of Nations has thus become in effect an alliance of those nations who do possess the resources and raw materials required to support their industrial populations. Such are Great Britain with her dominions; France with her colonies; Russia with her vast undeveloped territory. To these are joined in the League those nations who owe their very existence or material advantages to the Treaty of Versailles. Such are Poland, Czechoslovakia, Roumania, and others. These fear that they may themselves be swallowed by force by the great industrial nations who lack resources. They, therefore, cling to the League for protection.

So the world is back in the old system of alliances; the "haves" against the "have nots". And at present the "haves" are Great Britain, France and Russia. The "have nots" have not yet formed an alliance and may not do so if they are successful in grabbing sufficient resources from defenseless or weak countries.

But it is hard to see where these are to turn for this plunder without trespassing on the lands of the League members. Germany certainly seems shut in as by an iron ring. This leaves an explosive and very dangerous situation in Europe unless indeed the great nations cure it by throwing down their tariff and trade barriers. Such a policy would release this pent up danger and dissipate it without much harm. But the nations of the League, and the United States, are not making any move toward this solution. Germany is, therefore arming on a very great scale, for war—horrible as it is—is better than mass starvation with its accompanying terrors. Europe then is in danger of another war involving not only Germany, but certainly also France and Great Britain and probably also the other principal European nations.

SO the United States have two possible sources of danger. One is that some warlike nation might try to seize part of our territory to add to its wealth. The other is that we might not be able to keep out of a great European war.

As for the first, we are accustomed to consider the oceans that divide us from the other military powers as adequate protection. This is not now nearly so much the case as in former years. In the World War it was shown that armies of vast size could be moved across the sea in a short time. Modern transportation, ships, and planes, make this possible. Italy is about 2000 miles by sea from Abyssinia, yet her movement of troops and guns, etc., has been rapid. Moderate measures for defense should, however, meet this danger for experience shows that with modern weapons of defense and trained soldiers to oppose them those who attack from the sea are at a decided disadvantage.

The second, namely whether we could keep out of another great European war, raises a more serious problem. If we could not, we would again be called upon to become a nation in arms sending millions of our soldiers and vast stores of arms and supplies abroad. In the last World War we kept our determination not to be drawn in, until two principal considerations, with others, overcame our unwillingness. One of these, and perhaps the principal one, was

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the fear that if the Germans were successful they would in time take England by force and by starving her out, and then ultimately attack the United States also. The other was the sinking of ships and killing of Americans by German submarines, and the violation of neutrality.

That these losses alone would have brought us into the war I am not sure. But it seems probable that in any future great European war such losses might be much greater because of the development and increased use of aircraft. Attacks might even be carried into our own continental territory, while we were still neutral, by planes sent across the sea, or in airplane carriers. Such attacks might well be made for the purpose of destroying sources of supply for one or the other of the contending nations.

In this connection it is of importance to remember that the Covenant of the League of Nations requires the members not only to carry out the sanctions by refraining from sending the supplies, but also requires them to compel other nations to observe the sanctions, even though they are not themselves members of the League. Attempt might, therefore, be made to compel us to go far beyond neutrality in case the League made war upon any nation. If Great Britain were drawn into a great European war, it is hard to see how we could avoid being ultimately drawn in ourselves.

IN view of these possibilities it is wise to consider what means we should have for defense, and how nearly do our present Navy, Air Service, and Army meet these requirements.

In considering this problem it may be assumed that the American people will never go to war, but for defense. But it is hard to define defense. In one sense we went into the World War for defense. Yet our territorial integrity was not immediately threatened. What we feared was ultimate attack, perhaps after some years. We also wished to stop the killing of our citizens and loss of goods not contraband of war by submarine warfare. Defense of this sort required that we send our Navy and a great Army to Europe. That defense of our country in future may require similar action is, I think, not open to doubt.

We will not only have to defend against depredations on our own shipping, travelers and goods, but also against air attacks delivered here in the United States by airplanes flying from Europe, and perhaps returning thither, or going to airplane carriers. Our national defense is, therefore, of a different kind from that which might have been thought sufficient twenty years ago. It certainly requires that we shall be prepared to send our Navy and our air forces abroad, and perhaps great armies also. Our Navy may destroy an attacking nation's ships, but it cannot destroy its airforces for they come from the land. Only the other day Winston Churchill speaking in the British Parliament said that England had now more reason to fear the superiority of Germany in air forces than to fear her navy.

What we need for national defense must depend on:

1. The probable naval and military strength of the nation or nations that might attack us. 2. The aid we might reasonably expect other nations to give us. 3. Our isolation. As our defense may have to be by naval or military action in Europe or Asia, the question of our isolation is of major importance. It may be a hindrance to us in defending ourselves, if we have to fight abroad. For it makes the service of supply and movement of men and munitions much more difficult. It may also serve as a partial means of defense in case we are not successful abroad and have to withdraw to our own shores.

While this isolation in no way limits our need for a large navy, it does enable us to have safety without always maintaining so large an army as nations in Europe must have.

Our Army will hardly be needed in Europe or Asia for our defense, except as an ally to a nation or nations already at war there. In such case we can send a smaller force and still have some time to build up a huge army sending it over by divisions from time to time.

The like is true in case of attack in force upon us in America. Then also our isolation will give us some interval in which to prepare our Army. This is so because the enemy would first have to overcome our navy and air forces. Even, if successful in that, the enemy would have the difficult task of landing and maintaining themselves in hostile territory.

I believe it may safely be assumed that we will never have to defend ourselves against the British Empire. This at once cuts down the size of the navy, air force, and army that we need. However, our long coast line joined by the slender and easily broken thread of the Panama Canal requires that we have a very strong navy. The policy of our government in building up our Navy to a strength equal to that of any other country is justified. Indeed, it is necessary for our safety. The naval air force must also be in proportion.

This leaves to be considered the minimum strength necessary for our Army. Foreign nations have great armies and munitions and supplies in proportion. France has about 7,000,000 men, Italy about 6,500,000 men, Russia has about 15,000,000, Japan about 2,200,000. We come sixteenth on the list with less than 500,000 men. These figures include the trained reserves in each country. But as already stated, we are in an unique position with regard to our Army, for we will almost certainly have a short time in which to prepare after war begins. Furthermore, we may never, because of our probable allies, and our isolation, need so large forces as our enemies. Yet in case of a major war our Army must be numbered in millions of men.

BECAUSE of this probability, that we will have a short time to prepare our land forces after we are attacked, the United States has adopted a new system for defense. Under it, whatever will be needed immediately, such as the navy and the air force must be maintained full strength, armed, manned, and equipped for prompt action. Other elements of defense must be fully planned out, and so far ready that when the need comes, they can be quickly completed. The last is the new principle in our system of national defense. It is worked out by selecting those things necessary for a great army that take longest to get ready in sufficient quantities; and then, having learned what these are, preparing them so that they will be at hand when the troops are assembled and about to use them.

The first of these things is a skilled body of professional soldiers to plan everything in advance; and to keep the plans up to date; to organize for the future; to teach and instruct each other and certain civilians such as the National Guard and the Reserve Officers; to obtain and care for munitions of war and supplies. This is the Regular Army now authorized at a strength of 12,000 officers and 165,000 enlisted men.

The second is a force of citizen soldiers, not professional, but well trained and equipped, ready to meet and check at-

tack in an emergency in case it should come too quickly for the rest of the citizens to prepare to meet it. It is much less costly to maintain than the Regular Army, for its officers and men are civilians who give only a small part of their time. This is the National Guard which now has an authorized strength of 14,183 officers and 175,248 men.

The third is the frame work, including many of the officers and some of the men of the main body of the great citizen army. The plan is excellent and well suited to our needs. The framework is well devised. It is territorial. The units of the citizen army are spread over the country like a huge net. The company which, in case of war, the men of each locality will join, is assigned to a particular locality, and the officers for it, generally local men, are selected. These companies are grouped into battalions, also local with local officers, and these again into local regiments, and so on, for four armies of several million men. The plan is excellent, but it has been only partly carried out in the sense that those parts of it that take longest to prepare must be made ready in time of peace.

A CITIZEN army is made up of men called from the farm, office, and factory and who have yet to be trained, equipped, supplied and transported. Training must commence as soon as, even while, the men are assembling. One of the immediate necessities, therefore, is well selected and trained officers. It takes time to select the right men to be officers and non-commissioned officers, and still more time to teach and train them to be skilled officers. Here then is one thing that must be well done and kept up to date in time of peace.

But this is not now being fully done. Indeed, it is less than half done. It is estimated that at least 120,000 commissioned officers will be required for the great citizen army. Only about 89,000 of these have been selected, and even these have been only partially trained. These officers devote a certain number of hours each year to study, to book work and class work, and about 20,000, less than one quarter of them, each year receive two weeks more or less effective training in camp on what is called active duty status. Such slight and occasional training cannot, and does not make really capable officers of them. The Reserve Officers should be increased to the number that will actually be required. and everyone of them that has anything to do with the handling of troops or munitions in the field should have at least two weeks training each year.

But more serious still is the entire lack of non-commissioned officers in the Organized Reserves. It takes almost as long to select and train good sergeants and corporals as to train the commissioned officers. And they also need much instruction to keep them ready for service. Without them the training of the citizen army will be much slower and more difficult. At least 120,000 of these sergeants and corporals are needed to make the plan of national defense successful.

The cost of completing and maintaining this framework, and of giving the necessary instruction and training is very small by comparison with the cost of the National Guard. It is, if well carried out, the cheapest form of adequate defense our country has ever had.

THE fourth essential element in our national defense plan is to have always ready those munitions which take time to make in quantity. It takes many months to make cannon in quantity. And this is so, even if the munition plants, the factories, are fully equipped and ready to start work at once. The same is true of tanks and of airplanes, and certain types of shells, and a number of other absolutely essential weapons. You may recall that in the World War we did not use cannon made in this country, nor airplanes, nor tanks. For these, and many other things, we had to depend on our allies who furnished them to us in quantity. It is true we tried our best to make them for ourselves, and spent millions of dollars over it. But the year and a half we were in the war did not give us enough time. Officers and soldiers, no matter how well trained, are helpless without arms and ammunition in sufficient quantity.

The guns, tanks, planes, ammunition, rifles, etc., of the time of the World War, have almost all been superseded by better and more effective weapons. We have no great stores of these things, and what is worse, we have not even enough factories and machinery required to make them in quantity. Here then is another weakness in our plan of national defense that may make it quite worthless.

Our plan of national defense as now carried out has, therefore, two great weaknesses that seem to make it largely ineffective:—First, lack of enough well trained officers and non-commissioned officers; and Second, no adequate supplies of modern munitions, and no means to produce them quickly enough in sufficient quantities.

The people of the United States should know these things, and they should not rest in a mistaken sense of security. The fault lies with Congress for failing to give the War Department the funds required to carry out the plan of national defense. This plan Congress itself wisely provided for in the National Defense Act of 1920. But it has not made the appropriations of the moneys necessary to carry it out.

The Congress will no doubt quickly provide what is required if the citizens call the need to its attention. Your great organization can be very effective in helping to accomplish this. (*Editor's Note:* The above address was presented by General Delafield before a group of men's clubs, St. Paul, Minn., November 11, 1935.)

The Basic Biologic Aspect of War

Let's Be Sensible in Our Discussion of Causes

By Leon A. Fox*

I AM to discuss the basic biologic aspect of war. I abhor war. Certainly, everyone in this room must feel in the same way about this, the most horrible scourge that mankind knows. Compared with war all other catastrophes appear trivial, for war all too often brings with it those other dreadful plagues, epidemic disease and famine. Military surgeons should not be surprised to hear an army doctor speak of his dislike of war. The sentimental "peace at any price" pacifists who rant about the horrors of war do not have real first-hand knowledge of the true horrors of war like we who have seen young men die in concentration camps with epidemic disease and have treated wards filled with battle casualties.

I know that every doctor if he had a method or formula that would prevent war or even reduce the number of wars would consider it his greatest scientific accomplishment and would take the same pride in giving humanity his discovery that physicians take in sponsoring measures to prevent disease. I liken the prevention of war to the prevention of disease because this is the age of preventive medicine. Since the introduction of bacteriological methods by Pasteur and Koch we have made great advances in preventing disease. Military surgeons of all countries can take special pride in our own contributions to this field.

The triumphs in preventive medicine have greatly reduced the incidence of many of the communicable diseases that prey on the military forces. In the future the soldier who must die will have a better chance of dying on the field of battle from wounds received at the hands of the enemy. In the past far too many have died from disease contracted from friends and associates many miles from the front.

This group who represent those who have made it possible to save many will not be satisfied with limited objectives but will plan and try to do more. Why not even apply the same methods to the prevention of all war?

PROGRESS in the control of the communicable diseases has been made since we understand the nature of infection. Epidemiologists have almost come to believe that once the cause and method of infection are thoroughly understood, the disease is practically controlled. If such were the case we might hope that a thorough understanding of the causes of war would offer equal hope of preventing future conflict. Unfortunately we must remember that epidemiologists cannot control all communicable diseases. In fact our failures are as frequent and glaring as our triumphs. We have made wonderful progress in controlling the intestinal diseases through the development of sanitary engineering, water purification and the pasteurization of milk, but we must not forget that although we understand just as much about the transmission of many of the respiratory diseases, with this group we have accomplished very little. The reason we have failed in handling the respiratory diseases is because man is a social animal and these infections are spread by his normal commercial and social contacts. We cannot change his biologic attributes. Man is a gregarious animal and will not give up all social contact and exist as a hermit, even to escape respiratory infections.

We have made wonderful progress in preventing and controlling the insect transmitted diseases. We know much more about the way such direct contact diseases as the venereal diseases are contracted and yet we have made almost no progress in controlling these venereal diseases. The reason is the basic biologic nature of man. The Almighty in His wisdom did not leave the perpetuation of the race entirely to instinct. Where the control of disease involves some change in the nature and habits of man but little progress has been made. Little may be expected.

We may well analyze the nature and causes of war to see to what extent it is preventable. We are physicians, we will be honest, we will make the same scientific approach that we use in our efforts to combat disease. It is not believed that our experience in controlling disease would lead us to expect to prevent war with sentimentality, idealism or even prayer. I say this with no lack of reverence. I do not believe such a group as this pictures their God as a vengeful being who scourges mankind with epidemic disease. Since some epidemic diseases can be controlled by removal of the cause, let us analyze the nature of war and see if we can find the real basic cause of conflict. When we dissect out this horrible spectre and lay bare the real causes of war then we can see if they can be corrected or removed.

WHAT is war? War is the conflict of nations or states. It differs from individual conflict in numbers only. The same principles apply when two men fight as when armies contend. The same methods are used. In fact there is nothing distinctively human about war except the use of weapons. We find combat individual and collective all through the animal kingdom. War is a manifestation of the struggle for existence, the basic biologic struggle that has allowed the fittest to survive and evolve into the myriad of highly differentiated and well adapted living types that exist today. We cannot limit the struggle for existence to the animal world. We find the same struggle in the botanical world, the struggle to survive. What are the basic biologic requirements for the survival of the individual and his species or race? Food and a mate. With modern man combat is always an economic struggle. Primitive man and all lower forms also fight to live. The struggle for existence is then reduced to basic terms, the fight for food and females.

Those of us with biological training know that the struggle for existence has not given us a cruel, bitter, purposeless destructive force, but a wonderfully selective and constructive upward trend. Nature is rarely impulsive and violent but works ever upward and onward slowly evolving adapted improved types. We see this all about us in the entire living world, throughout the animal and plant kingdoms. Certainly, man, the crowning triumph of this great force cannot

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forget that improvement continues. Homo Sapiens is not a finished product. Who would be so rash as to predict limits for this Divine force? The Bible says God created man in His image. We biologists live in the present, not in the past. We believe God is creating man in His image and that man is improving and becoming more God-like as his life and religion take on more and more spiritual and ethical values.

This triumph of mind over matter, the development of the good brain even at the expense of a weaker back, took on great impetus in the last century when the great biologists with almost divine insight were able to formulate and give to the world the concept of organic evolution. This concept so clearly stated and demonstrated by Charles Darwin has stood the only real test of truth: "The ability to explain natural phenomena and extend further the frontiers of human understanding." This concept is now the keynote of all biologic science and philosophy and has so greatly increased man's perspective that it has been extended to the entire physical world and yesterday's philosophical gropings of Herbert Spencer, form the basis of today's scientific studies by Eddington, Jeans, Einstein and many others. This concept of purposeful orderly creation and development has given man such a wealth of knowledge that the entire scientific world today builds on this basic structure.

PLEASE do not think I have digressed from my topic or stopped to graze in my favorite scientific pasture, the field of organic evolution, without cause. To build a sound durable structure you must have a sound foundation in philosophy and science as well as architecture. What was the basis of Darwin's reasoning and logic? Charles Darwin and Wallace both gave all the credit for the idea of organic evolution to Malthus' essay on population. I wish to discuss the great essay of Robert Malthus. Malthus is one of the prophets whose work has been neglected. His studies on population are the foundation of one of our most certain biologic laws. Malthus deserves all the credit for the law even though he did have precursors in Buffon and our own Benjamin Franklin. Malthus showed that human populations depend on food supply and not on the rate of biologic increase. It is impossible to state the Malthus hypothesis correctly without seeing that it is axiomatic. Biologic observations, especially those of the ecologist, the world over, support the law. Every experimental set-up has also confirmed the Malthusian hypothesis.

Many of the experiments cited by modern biologists who claim to show other more important factors influencing population than the food supply when closely studied prove only that the Malthus factor is universally important. For example, if we use the experimental curves with the horizontal line A B representing the food supply and the population curve C D approaching the line A B, many who do not have first-hand knowledge of Malthus' teaching expect some sudden catastrophe when the two lines collide. No catastrophe results because as population saturation is approached food procurement becomes more difficult. Malnourishment lowers the reproductive rate and many young perish in the struggle for food. The line C D curves below the food supply line A B. This phenomenon does not disprove the Malthusian hypothesis. It shows only that the Malthus factor starts to operate much earlier than we supposed.

The ecologists see the operation of this Malthus factor all about us. The number of living organisms in any stream of water depends on the food supply, often the amount of sewage present, and sanitary engineers use this factor in measuring the degree of contamination present. The number of rodents and herbivorous grazing animals depends on the vegetation and these in turn support a corresponding number of carnivora.

Only the economists reject Malthus, so he is truly the prophet without honor in his home, for his work was a study of human population, and he was, above all, an economist. I can understand the rejection by the economists only by presuming that they do not read Malthus. They read about him. If they read Malthus they would know that only the first chapter of his work is devoted to the expounding of his theory of population, and that all the rest of this great work is devoted to showing how man, as a thinking animal, may circumvent the dire consequences of unlimited increase in population. In his study he considers all of the factors that modern economists think they have discovered. He was familiar with the fact that any given acreage would support more agriculturists than hunting tribesmen. He was also familiar with the fact that improving agriculture would support greater populations, and had intelligence enough to appreciate the limits that nature set on this increase. I repeat, the economists do not read Malthus or they would not make so many ridiculous statements. Is it any wonder that most natural scientists smile when the economists refer to themselves as scientists, since they neglect the basic biologic laws in dealing with man, an animal? We will not have time to discuss Malthus' work in more detail, but if any reader has neglected to read this great work he should not deprive himself of this privilege longer; but read Malthus—do not read about him.

I have stressed this work because I consider all combat biologic, all war basically biologic. My thesis is that all combat is caused by the struggle for food and females. Possibly I should say food and sex, because sometimes it is the deadly female that engages in combat.

IT is customary to picture the subhuman forms as terrible organisms that fight for the sake of fighting, an animal world that destroys itself because of vicious instinct. Could anything be further from the truth? The terrible lion and tiger are only terrible when hungry. With a full belly they become as sleepy and harmless as any well-fed cat unless disturbed by man or beast. I should add, of course, that they fight for a mate.

We will scan the realm of living things. If we start with the minute, unicellular, sexless organisms we find that the Malthus factor is the only thing in the struggle. The population depends on the food supply. When we proceed up the biologic scale and reach the level where sex appears, the struggle for a mate immediately becomes manifest and is second only to the basic fight for food. I cannot take the time to slowly climb the zoölogic tree with you. We must hurry up to the uppermost branches where our fellows are fighting. But some time at your leisure make a slow mental ascent of this same tree that we are rushing up, and notice the detail of the struggle for existence and the cause of the combats you will see all about you.

We are now almost at the top of the tree, up with the anthropoid apes. They have numerous conflicts. They rend and tear each other with tusk and claw. I do not need to tell you what they are fighting for. Notice they have no weapons, no tools.

We are going higher. We come to the pre-man, quite human in form, but not men. They have no tools or weapons. The struggle for existence is just as intense. They fight but they can only bite and claw and choke an adversary. The combat is often decided by the opening of a carotid artery.

The human level is reached only when we find tools, and the first tools were weapons—tools for hunting and combat. The first ape to swing a club over his shoulder was a man, the primitive father of Homo Sapiens. We are at the human level, a low level it is true, and still we have nothing to fight over but food and females.

Do you question the importance of food in human war? The earliest wars of which we have a completely satisfactory account are the Greek-Persian conflicts. We owe much to the father of history, Herodotus, and how we thrilled in our high-school Greek classes as we mentally marched with Xenophon and Cyrus and the immortal 10,000. We fancied the Greeks as almost warrior gods, but come back to earth—propaganda did not begin in the World War. Old Homer and Xenophon could give our modern G-2's and propagandists all the aces and beat them at the game of working up enthusiasm for a Holy War.

The Greeks lived on a peninsula. If they were to grow, to increase and develop, they must have trade. The city states that failed to realize this and did not establish colonies and commerce could not survive. Trade brought them in conflict with Xerxes. The failure of the Greek city states to unite to defend their trade is the reason they had to wait for Alexander to conquer the world. If the Greeks had united, Alexander would not have had a chance to steal their birthright. The Greeks were meant to be the conquering nation.

The Punic wars were not fought for the glory of Hanibal, or Scipio Africanus, but to decide whether the Phoenician Colony of Carthage should continue to eat or not. Rome decided that the food and wealth that went to Carthage was needed at Rome. Is it any wonder that we hear old Cato thunder in the Roman Senate, "Carthage must be destroyed"? Carthage was destroyed. Do you think the hordes who pressed on and destroyed Rome were looking for polo fields? No, the migrations were caused by the pressure of population.

Do not think that modern wars are different. Is there anyone so dense today that he considers any other cause for the World War except commercial conflicts? Forget the war propaganda and consider the basic commercial conflicts. They are numerous and involved. They are the real causes of the war. Remember it is the load that breaks the camel's back and not the added straw. The same may be said about the spark that appears to cause a war. Commercial wars are wars for food. Consider the significance of Germany's plea for a place in the sun. The Germans did not refer to heliotherapy. They wanted trade, food. The question involved was food—food for England, food for France, food for Germany and many others.

I HAVE stressed these fundamental biologic factors because I do not believe some pacifists consider them when they cry out to nations that it is always possible to sit down at the peace table and settle their differences. Sometimes the differences are serious and involve such important questions as: Whose sons and daughters are going to eat?

Let us look at some of the sore spots in the world today. We will not play favorites. It is not necessary to leave this hemisphere. Cuba in 1899 had a population of 1,572,845. The island had been occupied for 400 years. Its population was growing very slowly although the people were of a race and religion that will increase just as fast as the food supply will allow. After the war with Spain, American capital was literally dumped into the island. Roads were constructed. Refineries were built. Utilities were developed. The Cuban laborer before the war worked in the sugar cane fields or did not eat. During the building boom work was plentiful. Everyone could eat. The population grew like wild fire. In twenty years it had almost doubled. The census of 1919 was 2,898,905 and the momentum carried it to over 4,000,000 in 1933, the last census.

Cuba now has almost three times as many people as in 1899. Certainly twice as many white people as a tropical island, the size of Cuba, can support properly with agriculture alone. Some were foolish enough to think that Cuba's population had been held in check by yellow fever and malaria and that improved sanitation caused the increase in population. I question if these important diseases had the slightest effect. The causes were economic. Cuba's population will not continue to increase. They are feeling the pressure now. If Cuba were not an isolated island she would be having "growing pains," boundary disputes with neighbors. Cuba is not powerful enough to threaten the world with a navy. The climate is not conducive to great enterprise. Mañana. Her population will regress. She will not go to war. A hundred years from now the rapid growth and subsequent fall of Cuba's population will be regarded as a much more typical Malthusian experiment, than the wonderful laboratory demonstrations conducted by the biologists of the time.

Just a year or so back Japan almost monopolized the front page with the military occupation of part of Northern China and the establishment of the puppet state of Manchukuo. Let us analyze the factors that made this necessary or desirable. We shall look at the problem from the Japanese point of view. In 1853 when Perry sailed into the Yedo Bay and trade and contact of the island with America and the rest of the occidental world started, the population of Japan was probably less than 30,000,000. By 1900 it had grown to 45,000,000. The pressure of population was intense. Remember the population in 1853 represented saturation for the economic conditions prevailing at the time. Trade and commerce allowed an increase and the momentum carried it to the point of pressure. Result—The Russo-Japanese War. The Japanese victory and Korean expansion stimulated further growth—then pressure—then—well, I see no outlet in China—The only trouble in China today is too many Chinese. The Malthus factor has been at work for generations in China. I do not believe it will be easy to limit Japan and I feel that it may be presumptuous for any nation to set a limit. Today there are close to 70,000,000 Japs in the homeland and the Japanese Empire numbers over 90,000,000. The original islands with the most intense agriculture will not support properly half these inhabitants. Before any individual says we have too many Japs or even enough of this race, I would like to have him name any race that has made as much progress in the last half century. Japanese troubles are not caused by any ruthless desire to kill off the Chinese race for sport or vain military triumph. The Japs are faced with the problem of feeding 90,000,000 Japanese and the 90,000,000 hungry mouths must be considered when you talk of the cause of trouble in the Orient.

TODAY we have a war threat. Some are ridiculous enough to think that Mussolini is anxious to declare an open season on Ethiopians. Fortunately the world powers are not so deluded. All of the nations are fully aware that Italy's troubles are economic. What nation has shown as much post-war virility as Italy and to get at the crux of the question, what old nation has shown such growth? Italy's population has increased 16 per cent since 1918. Italy is not blessed with great mineral resources and the soil has been intensively cultivated for close to 3000 years. Italy has had population problems for years. Formerly many Italians migrated to other countries, especially the United States. This outlet has been closed and it is significant that most nations refuse to accept immigrants from Southern Italy and Sicily, the area where population presses hardest.

Italy does not care to waste money on vain military glamour. I do not believe Italy has any vicious desire to conquer Ethiopia or any other country. Italy desires only to grow and develop. Again I wish to remind those that may say we have enough Italians, that we do not have enough of the type of Leonardo da Vinci, Michael Angelo, Botticelli and Raphael. We do not have enough scientists of the type of Galileo, Spallanzani or Marconi. The whole continent of Africa has never produced a da Vinci, a Galileo or a Dante and never will unless he comes from the loins of a son of Italy. I am not discussing the merits or demerits of the Italian cause. I am calling your attention to the fact that Italy's problem is basically economic, not due to a desire to parade her military strength and forces before the eyes of the world.

The acutely inflamed areas that I have called to your attention are by no means exceptional or unusual. I have chosen these widely scattered examples only because their diplomatic teapots are boiling at the present time.

Is there anything practical we can gather from this discussion of war causes? I hope so. Certainly it must be apparent that the clamor for early marriage and large families, that comes so persistently from the very nations that are suffering from the pressure of population, can only make their suffering more acute. The position of the church, I refer to all creeds, in always demanding a rapid increase of population, is also hardly consistent with their laudable but misguided pacifism.

The position of the poorly informed economists who question the very importance of the Malthus factor and state that there is not a shortage or even limit to the food supply but that the rich have too much and the poor too little and that all problems are caused by improper distribution, is likely to cause most unrest and greatest catastrophe. This type often live in the land of hyperbole and Brisbania and make such far-fetched statements as "Texas can feed the world, *if*," "The Argentine can be made the butcher shop for the world, *if*" or "Australia can do something else, *if*." There is always a large "If." However, there is an element of truth to the ravings of these "crack-pots." It is this: if the world supplies were absolutely equably distributed living conditions in China and India and some other areas would certainly be raised and, most important for English and American pacifistic internationalists to remember, that in the leveling process, living conditions in England and America would be lowered proportionately. It must also be remembered that this leveling would not bring peace or contentment even to those temporarily helped, for it is a characteristic of man that as soon as you give him a maintenance diet he gets his national head up and shoulders back and demands "Red Meat" and starts to talk of "Standards of Living." The fight for world dominance would begin all over.

Before I leave this question of population and food supply I wish to stress that I am not discussing birth control. I am only calling your attention to the fact that the pressure of population and the fight for trade and commerce are the real basic causes of war.

BEFORE closing I wish to review with you some of the consequences of the failure to give proper consideration to the true biologic causes of war. I firmly believe that the reason our peace advocates and peace conferences have failed so miserably is because they have not approached the prevention of war from the etiologic aspect. They have not considered the causes of war but have in every case with misguided sentimentality discussed the methods of making war. If one listens to the clamor of the pacifist he would believe that all wars are caused by the manufacturers of munitions. Geneva has not remained free from this ridiculous fallacy for we have the peace commissions of the League of Nations, instead of considering the basic economic causes of war, dealing with the methods of making war. We find this great body dodging the true issues and giving time to the discussion of the caliber of artillery, the use of submarines, airplanes, chemicals, etc.

One would think war was a sport and that we must regulate weapons like we do the weight of boxing gloves. They forget that weapons have evolved and improved as mankind has evolved and improved and that the most enlightened and educated nations are the nations with the most effective scientific fighting machines.

If the proposals of our pacifistic friends were carried to the nth degree and all weapons were barred they could not expect to prevent conflicts unless they remove the basic economic causes of war. It is not the tusk of the boar, the antlers of the deer or the spur of the cock that makes these animals pugnacious. You cannot cage two game cocks together; even if you saw off their spurs, you will only prolong the misery of their conflict. Neither can you prevent war by reducing combat from the level of brains and intelligence to the brute level of tusk and claw.

War cannot be prevented by destroying the munitions factories. Possibly peace may be more firmly established when the real biologic causes of war are considered and efforts are directed toward adjusting the basic enconomic problems.

The First Ballistician

The Life and Works of Tartaglia of Brescia

By Thomas M. Spaulding*

UNTIL gunpowder was invented there could be no science of ballistics as we know it. But it is an odd thing—and typical of the mediaeval mind—that artillery had been in practical use for nearly two hundred years before any study of the action of powder or of the path of the projectile was made public. Early in the sixteenth century Leonardo da Vinci gave some study to such matters but his notes remained unpublished and unknown until modern times. He was recognized in his own day as a great artist and a great engineer. It was known that he was also constantly busy with unpractical speculations on mathematics and mechanics, but this habit was regarded by his friends as the amiable eccentricity of a great mind, of no more significance than an engineer's passion for crossword puzzles nowadays. So the publication of Niccolo Tartaglia's *Nova Scientia* in 1537 came like a sudden burst of light on the scientific world, with no previous twilight or dawning.

Tartaglia stands out as one of the great figures in the history of mathematics. We are not concerned here with his mathematical works, however, but only with his ballistic studies in which he has the distinction of being a lone pioneer. Our knowledge of his life is surprisingly full, considering the time when he lived and the obscurity from which he rose, for his works contain a great amount of autobiographical detail.

He was born in Brescia about the year 1506, the son of a diminutive letter carrier commonly called Little Michael the Courier, who died when the boy Niccolo was a small child, leaving his family in great poverty. In 1512 the city was taken by the French under Gaston de Foix and subjected to a sack of exceptional atrocity even for that savage period. Niccolo was cruelly treated by some French soldiers, his jaw broken, and his face so disfigured that in his adult life he concealed the scars with a beard. He had no proper surgical treatment of any sort and was left with a permanent infirmity of speech which gave him the nickname of Tartaglia (or Tartalea)—"the Stammerer." In time this became his recognized surname, superseding his original one, which is sometimes said to have been Fontana and sometimes to be unknown. In spite of poverty and physical handicap the boy was determined to get an education. He tried to learn under a school teacher, paying with his own earnings, but his money ran out when he had only learned the alphabet as far as the letter "K," and thereafter he was his own and only teacher. Yet by 1521 we find that he was teaching mathematics at Verona and he soon attained to European reputation. He removed to Venice in 1534 and remained there for the rest of his life except for a period of eighteen months, about 1548 or 1549, when he taught in Brescia. He died in Venice in 1559.

TARTAGLIA first became interested in ballistics in 1531, when someone asked him what elevation of a gun would give the greatest range. Until that time he had paid no attention to military matters, not even noticing the plan of the fortifications surrounding the towns in which he lived or visited. He came to the conclusion that the greatest range was attained with an elevation of 45 degrees, and that the trajectory was a curve, approaching closely to a straight line at the beginning and end. The exact nature of the curve he never discovered; it was Galileo, some seventy years later, who declared it to be a parabola. Now this idea of a curved trajectory was nothing short of revolutionary. The accepted notion was that the projectile travelled in a right line until its energy was exhausted and then dropped straight to the ground. (If we could get a projectile to behave like this now it would assuredly help in the delivery of vertical fire.) Such ideas are simply inconceivable to the modern mind. Did no one ever watch the stone that he threw in the air? But the mediaeval man was guided by authority more than by experience. To suppose that a projectile curved through the air would be to deny the truth of Aristotle—and this was unthinkable. Even as late as 1561 Daniel Santbech published a large work on astronomical and geometrical problems some of whose illustrations show artillery bombarding fortresses in the Aristotelian manner.

For a time Tartaglia kept his ballistic studies to himself. Then, unwilling to make improvements in the art of killing men, he burned his notes and discontinued his investigations. But in 1537 the prevalent fear of a great Turkish attack upon Christian Europe caused him to resume them and to publish his views under the title, *La Nova Scientia.* This deals with the flight of projectiles and also with the measurement of heights and distances. The book aroused great interest everywhere and brought Tartaglia an extensive correspondence, which resulted in 1546 in the publication of *Quesiti et inventioni diverse,* strangely dedicated to King Henry VIII of England. Part of this treats of non-military matters, part of fortification and tactics, and part of ballistics. A third work of ballistic interest is the *Regola generale di solevare ogni fondata naue et nauilli,* first published in 1551, which is not confined to methods of raising sunken ships as stated in the title. The composition of gunpowder is discussed, among other things, and its invention attributed to Archimedes.

All of these works went through several editions, and their influence was great. It was upon the foundation laid by them that the science of ballistics was built. Some of Tartaglia's ideas proved sound and showed the way to further advances; some, as might be expected, were false, but even these serve a good purpose in making his books readable and entertaining. We should be sorry to miss the story of "how a piece that had been oft-times charged and discharged, drew into its concavity a little dog; which by chance did in going by, smell the mouth of it." Theories which were incorrect might be quite reasonable in the light of the knowledge of the time; for example, that the second of two consecutive shots would travel farther than the first, because "it doth find the air not only wholly stirred with the pellet of the first shot, but also much tending or going toward the place to which it is shot." In general, though, Tartaglia took no account of the effect of the air and ignored it entirely in his calculations.

None of these books can be called rare, but they are some-

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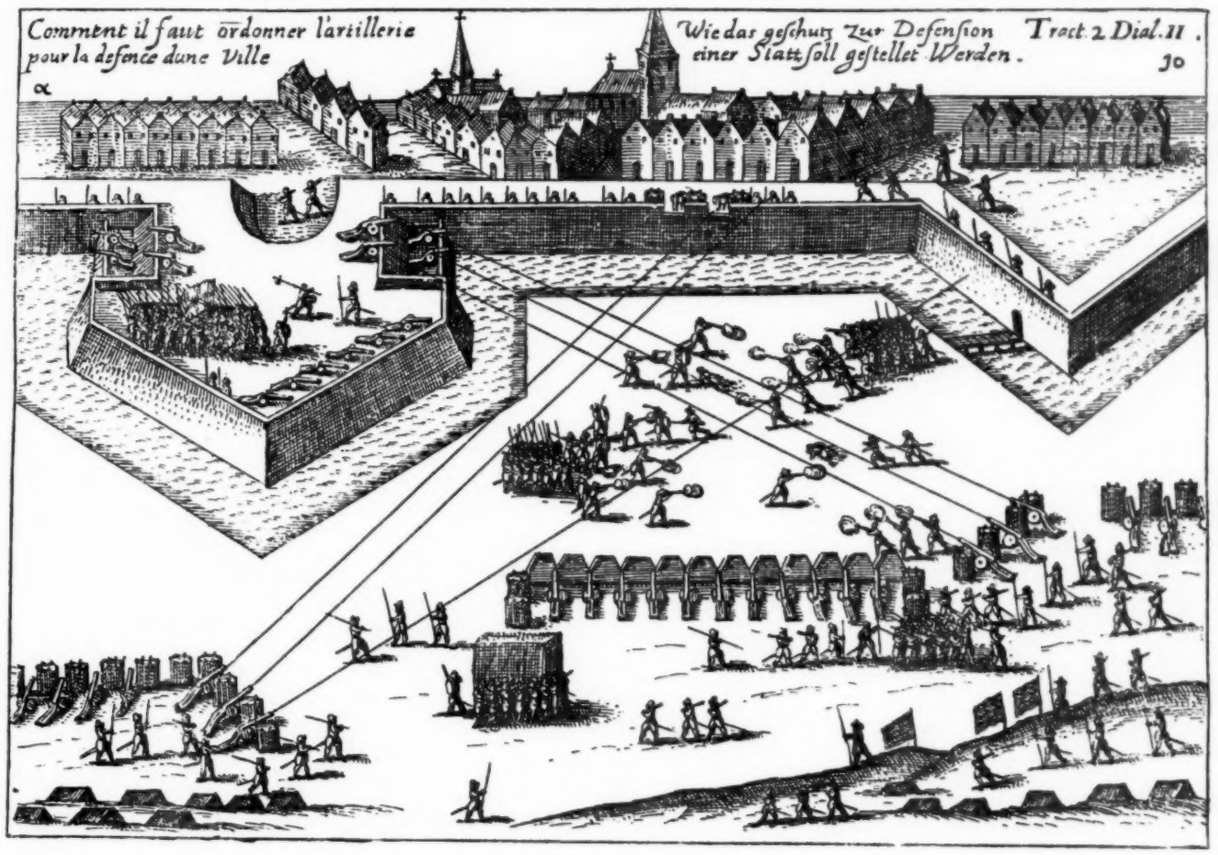
Comment il faut ordonner l'artillerie pour la defence dune Ville
Wie das geschutz zur Defension einer Statt soll gestellet Werden.
Tract 2 Dial. II.
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From Norton's "Gunner", 1628.

what unusual in this country. Many large libraries have none of them and very few have all, in any edition. There are copies of the *Nova Scientia* in the Boston and New York Public Libraries, the John Crerar Library (Chicago), the Universities of Chicago and Michigan, and Columbia, Cornell and Princeton Universities. The *Quesiti* may be found in the Library of Congress, the New York Public Library, the Engineering Societies Library (New York), the John Crerar Library, the University of Michigan, and Harvard and Western Reserve Universities. The *Regola Generale* is in the Library of Congress, the Boston Public Library, the John Crerar Library, the University of Michigan and Columbia University. This list is by no means complete but may help an inquirer to locate a copy somewhere within his reach.

If the text in the original Italian is hard to obtain, the versions in other languages are worse. A French translation by Rieffel was published in 1845. There must be copies somewhere in this country but I do not know where; there is none in the Library of Congress. An English translation of the first three books of the *Quesiti,* with a valuable supplement, was printed in London in 1588. The title reads: "Three books of Colloquies concerning the arte of shooting in great and small peeces of artillerie, variable randges, measure, and waight of leaden, yron, and marble stone pellets, minerall saltpeeter, gunpowder of diuers sortes, and the cause why some sortes of gunpowder are corned, and some sortes of gunpowder are not corned: . . . . now translated into English by Cyprian Lucar Gent." And the title of the supplement: "A treatise named Lucar Appendix, collected by Cyprian Lucar gentleman, out of divers good authors in divers langvages: To shewe unto the Reader the properties, office and dutie of a Gunner, and to teach him to make, and refine artificiall Saltpeter: to sublime brimstone for gunpowder, to make coles for gunpowder, to make gunpowder of diuers sorts & of diuers colours, to make gunmatches, touchwood and firestones, to know the waight and measure of any pellet, to make carriages, ladles, rammers, scourers, and cartredges for any great peece of artillerie,"—and much more, amounting to a full table of contents. The only copy that I know of in America is in the Newberry Library (Chicago). There is none in the Library of Congress. Probably the Huntington Library in California has a copy, for one of its specialties is English books printed before 1640, but I have not verified this.

The portion of the *Quesiti* dealing with the composition of gunpowder was also published in English in 1670, in a compilation by Henry Stubbe entitled *Legends no Historie.*

One other achievement of Tartaglia's should make his name memorable in artillery and ordnance circles: he was the inventor of the gunner's quadrant.

EDITOR'S NOTE: The above illustration is reproduced from "A Bibliography of English Military Books up to 1642 and of Contemporary Foreign Works" by Capt. Maurice J. D. Cockle. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd. 1900. The complete title of Norton's "Gunner" is "The Gunner, Shewing The Whole Practise of Artillerie: With all the appurtenances thereunto belonging. Together with the making of Extraordinary Artificiall Fireworkes, as well for Pleasure and Triumphes, as for Warre and Seruice. Written by Robert Norton, one of his Maiesties Gunners and Enginiers. London. Printed by A. M. for Humphrey Robinson, and are to be sold at the three Pidgeons in Paules Churchyard. 1628."

ARMY ORDNANCE

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Month by Month

RECENT changes in the command of the Air Corps have served to focus attention on the important functions of this great arm of our national defense. Maj. Gen. Oscar Westover, who succeeds Maj. Gen. Benjamin D. Foulois as Chief of the Corps, has had lengthy experience as a flyer and administrator. We have dedicated the frontispiece of this issue of ARMY ORDNANCE to General Westover and with it the fondest wishes of all Ordnance friends for a most successful tenure as Chief of the Corps. His predecessor, General Foulois, was a pioneer in this new department of military science. For him and his work there will always be a high regard on the part of all military and engineering students.

AIR DEFENSE

General Westover has had a distinguished military career. He was born at Bay City, Mich., July 23, 1883. He enlisted in the Army on September 4, 1901, and served as a second and first class private, Company "K", 3d Battalion Engineers at Fort Totten, New York, and at Washington Barracks, D. C., until June 15, 1902, when he was appointed to the United States Military Academy from Michigan. Upon graduation on June 12, 1906, he was commissioned a second lieutenant of Infantry.

General Westover was promoted to first lieutenant on April 13, 1911; to captain on July 1, 1916; to major, Signal Corps (temporary) on October 20, 1917; to lieutenant colonel, Air Corps (temporary) on August 14, 1918, and to colonel (temporary) on May 24, 1919. He reverted to his permanent rank of major, Signal Corps, on June 30, 1920; and was promoted to lieutenant colonel, Regular Army, on January 30, 1930. On December 22, 1931, he was appointed Assistant to Chief of Air Corps, with rank of brigadier general.

On Aug. 25, 1917, he was assigned to duty with the 11th Infantry at Camp Chickamauga, Ga., until Sept. 19, 1917, when he became Signal Officer, Port of Embarkation, Hoboken, N. J., on which duty he served until March 18, 1918. He was in charge of the Storage Department, Signal Corps, and Storage and Traffic Department, Bureau of Aircraft Production, Washington, D. C., from March to November, 1918. He was executive officer, Office of the Chief of Air Service, from November, 1918, to October 18, 1920.

He attended the Balloon School, Omaha, after graduation from which in March, 1921, he became Chief, Balloon and Airship Division, Office Chief of Air Service, Washington, D. C., to December 26, 1922. He attended the Air Service Airship School at Langley Field, Virginia, graduating in April, 1922. He competed in the National and International Balloon Races in May-July-August, 1922. He was a student at the Air Corps Primary Flying School, Brooks Field, Texas, from which he graduated in June, 1923; and a student at the Air Corps Advanced Flying School, graduating therefrom on December 28, 1923. General Westover was detailed as Assistant Chief of Air Corps on January 13, 1932. He received the Distinguished Service Medal with the following citation:

"Lieutenant Colonel, Air Service, U. S. Army. He served in turn as signal officer, port of embarkation, Hoboken, New Jersey, chief of storage department, Signal Corps, and chief of storage and traffic division, Bureau of Aeronautical Production, Air Service. By his great initiative, painstaking attention to details, exceptional ability, and untiring efforts he installed and developed with conspicuous success at all ports of embarkation a complete system of keeping records of shipment of Signal Corps and Air Service property for overseas. His services were of inestimable value to the Government in a position of great responsibility."

COINCIDENT with the change in command of the Corps, the Chief of the G. H. Q. Air Force was raised to higher rank. Maj. Gen. Frank M. Andrews, the first chief of the Force, already has demonstrated the value of this mobile, tactical organization. These changes in personnel and the coming of improved flying equipment in the Air Corps organization indicate in no uncertain terms that air defense is the new major trend of broad military strategy and tactics. It appears that we are on the threshold of development in our country of a well proportioned, fast-moving strategical organization as an auxiliary arm of our general defense structure.

It should not be necessary in any comment in these pages on the new rôle of the air arm to caution against any of the fabulous claims made for aircraft in modern battle. Some of our people are constantly painting pictures of the devastating effect of air operations upon civilian populations. These and other nightmarish claims arise too often from hysteria and ignorance of military objectives. The air arm, like cavalry, field artillery and the others, is a part of the military organization with a definite mission and a specified objective in broad military success. This arm has added improvements to older military forms in observation, reconnaisance and communication and of itself has become a new weapon dealing in ranges of miles rather than yards. Sensible people will not take too seriously, therefore, the sensational claim of the Sunday supplement writers that civilization will be wiped out by the airplane. Military commanders, whether astride a horse or aboard a fast pursuit plane, are more interested—it does seem—in preserving civilization than are our self-styled saviors of it!

Technical and tactical development of aircraft in and for our service is opening up new vistas of ordnance develop-

ment and coöperation which heretofore have been more apparent than real. Similarly, the field of chemical defense and communications has wide possibilities of advancement. Progress in the design and construction of the several types of craft has gone on faster than possibly any other field of scientific achievement in a decade. Speeds have been increased, characteristics have been improved, engines have been developed and the technique of construction has gone through an epochal period. Each of these has emphasized the changing demands on the ordnance equipment which makes a weapon of the airplane. Types of armament have had to keep pace with the changes of aircraft construction as they have come. Fortunately the adaptations of ordnance have not lagged although there is much yet to be done. The new Air Corps tactical organization has already placed emphasis upon the problems of ordnance supply. It is quite one thing to have an organization equipped with efficient planes and capable of tactical maneuver as we now understand it. It is quite something else to have an assured supply of the weapons with which those planes are armed and an uninterrupted store of weapon replacement for any given military mission. This is an important and pressing problem now on the way to proper solution.

FROM the standpoint of industrial preparedness, the program of the air arm also emphasizes the change in the time factor for producing the weapons upon which the program depends. In a major emergency consumption of equipment is greater and the demand is instantaneous. Thus where a certain time allowance can be made for other services such as Infantry, Field and Coast Artillery, so far as readiness is concerned, the factor regarding the air arm is considerably shorter. Planes will be in existence and ready for equipment while the older arms will take time to train manpower. Consequently relation of ordnance and air becomes vital. We must keep step with air progress so that the air mission may not be ineffective when emergency requires its use. Aircraft armament, an Ordnance responsibility in peace and in war, is as much a factor in the success of the air mission as are the design and production of engines, propellers and body materials. Our aircraft guns and bombs, just as our radio equipment and chemical appliances, must always be adequate in design and supply to meet demands of the flying mission. There is every indication that this relationship is being fostered as it should be. The leadership of the administrative and tactical groups of the Air Corps can depend not only upon the engineering and production skill of Ordnance but equally upon the brains and energy of America industry to produce the weapons as well as the ships when needed. Private industry, as usual, has developed and built planes having greatly advanced characteristics. Similarly, in time of emergency, private industry will not fail to produce the weapons. The relationship must be close, otherwise the ordnance phase of air defense may lag and we will be in the position of having a superb tactical outfit ready to go but a delayed weapon program for want of a reserve of equipment and ability to produce in a hurry. Air defense is the problem of the second quarter of the twentieth century. But we find ourselves sadly deficient in antiaircraft guns and auxiliary equipment. Now that we are strengthened afloat and aloft it is imperative that our ground defense equipment be strengthened particularly at and near our centers of population. Air defense means a balanced coördination of weapons on the ground and in the air—both must be real.

THE present legislation designed to keep the country neutral was passed by an hysterical Congress at the close of the last session. It will be in effect until February 29, 1936; unless extended or modified at that time it will lapse. With it the arms-control legislation would also expire. The Foreign Affairs Committees of both House and Senate are at work on a new neutrality bill to be effective on the expiration of the present one and it is assumed that the arms-control feature of the present law will be incorporated in the new act.

MUNITIONS CONTROL

It is fast dawning on our people that the exportation of arms is only a very minor phase of neutrality. Due to a great hubbub, fostered during the past few years by sentimentalists, weapons as such have been placed in a class along with drugs and alcohol, and around these three are woven a superstition that seems to connect them with an evil spirit. It has been rather pitiful to observe this attitude on the part of so many well meaning people. It is only natural that on second thought the absurdity of such an attitude becomes apparent and that consequently popular concepts of neutrality are at last coming back to earth.

In the hysteria over the arms question in the spring and summer of 1935 "munitions" was the one class of things which if controlled would stop war! Gullible yet sincere ladies and gentlemen seemed to think that everlasting peace would come upon earth when the iniquitous arms maker is, if not put out of business, at least watched with an all-seeing eye. Less than six months of trial for this philosophy under the law of the land has quickly convinced sensible folks that the production of armament has a very meager effect on the stimulation of war. They have been forced to the conclusion which should have been apparent at the start that modern war is simply a transposition of modern peace and that all the things people require in peace they need just as badly, and often more so, in war. Consequently a neutrality that rests upon arms control as its essence is no neutrality at all. Those who say that our old concepts of neutrality are obsolete must be prepared to admit that a new neutrality must prohibit trade in everything—raw materials, finished products and credit. It will not do to embargo shipments of arms to a warring nation and at the same time permit the free exportation of everything else a belligerent needs. So it all comes down to this very simple alternative: either we will supply everything or we will supply nothing. Few will contend that as a people we are willing to adopt the latter course —the wheat grower, the cotton planter, the miner would kick—and kick strenuously—long before the very few arms makers we have in the United States would raise a voice.

This estimate of all the foolishness of the present on the subject of neutrality and of munitions control does not mean for one moment that we are not heartily in favor of the present munitions control setup. Indeed now that munitions control is in effect we should like to see it carry on for a time in order that the merits or demerits of the philosophy may be proved. Not only that but it is a splendid vehicle for showing once and for all that most of the munitions hullabaloo is a straw man built up by a few politicians, aided and abetted by a few crack-brained individuals, primarily for their own aggrandizement. Sufficient trial will prove, if the people have not forgotten all about it and have not then turned their attention to reviving prohibition or toward the elimination of Sunday sports, that the whole approach has been very unrealistic and often times extremely absurd.

We have just received, through the courtesy of the World Peace Foundation, a copy of the League of Nations Statistical Yearbook of the Trade in Arms and Ammunition issued at Geneva in 1935. So far as the export trade of the United States is concerned, this compilation represents an analysis of statistics which is available monthly to everyone through our Department of Commerce. The League's figures show for the year 1933 a trade in all classes of military weapons—including such rank nonsense in classification as "blasting caps, dynamite, fuses, non-military powders and fireworks"(!). If we eliminate the item of blasting caps, fuses, dynamite and the others, we have a total export trade of about two and one-half million dollars for the year—a terrifically large and influential part of our total export trade for the same year of $1,675,000,000!

But many of our people still are led to believe that armaments are a prime cause of war and that their makers are outlaws. Whatever form the 1936 version of neutrality will take let us hope that it will include munitions control so that it may be shown once and for all how perfectly silly he or she is who says that munitions makers are the war makers and but for them the world would be at peace. So far as we can see the present neutrality, including munitions control, has placed peace in greater jeopardy than it has been for many a year. But that is the price that must be paid, apparently, to convince the people who have been misled by the demagog that the guide posts along the road to peace have been all wrong!

Oil for the Motors of America

Oil as an essential war material has been holding the headlines for the past few months. Just why oil is emphasized and not wheat or any of the other thousands of things armies need is a little mysterious. Still people's minds work that way and propaganda leads them to think that way so that oil looms into the headlines even though many other commodities might be referred to individually instead. The contention that you will stop a war by placing an embargo on rifles, machine guns and ammunition was proved to be a childish absurdity before the new arms-control legislation had gone into effect.

Messrs. Brooks and Snider, writing on "Oil and National Defense" in this issue of Army Ordnance, present aspects of the question which come home to us very directly. They write on a subject of importance. Their conclusions may not be concurred in by all geologists and with good cause. But at best our domestic supply of petroleum is not inexhaustible and if the authors' estimate is too harsh and their indications are 50 per cent too conservative still there is food for thought. It stands to reason that our domestic oil supplies are not limitless. Already the decreasing output, the number of dry wells and dependence upon imports indicate to the thoughtful person that we are not so immune to dependence on foreign sources ourselves. New methods of recovery, production from shale and hydrogenation have many disadvantages from the standpoint of quantity and price. So when the American people begin to take an international stand on oil they had best not forget that the day may not be far removed when the shoe may be on the other foot and we, like some other powers, may need all the oil from foreign sources we can get. Double-edged swords are always dangerous things!

A reading of the Brooks-Snider paper prompts the suggestion that this whole question is so important from a defense standpoint that it might well be given more emphasis in the surveys and plans of our defense services. So far as we know, petroleum is not included among the essential raw materials for which we may in a few years be dependent upon foreign sources for an important share of our national requirement. As the authors interpret their facts our present condition as to quantity and price may last another eight years.

In the last analysis, if oil should become a problem for us, plenty of motor fuel and oil can be manufactured from coal and shale by known methods. But the plants for such manufacture are not built and in all probability will not be built until the domestic shortage is not only apparent but has resulted in a considerable rise of price. In the meantime we shall become increasingly dependent upon imports. Aside from the need for a coördinated study of this problem as a part of our national defense, we had best go slowly with anything like a policy of economic sanctions. If in years to come the shoe should be on the other foot and we find that we need oil from a friendly country then by that time empty-headed politicians will have retired to private life and the Army and Navy will be left holding the bag. It usually works that way. Let's keep our wits about us and understand that we may not always be as self-sufficient as we seem to be now. It would be a pretty pickle indeed were we, in a a spirit of sanctimonious self-righteousness, to advocate denying oil to another country to force its hand in a cause that country considers just, and ten or twenty years hence find ourselves prosecuting a just cause of our own but with not enough oil for the motors of America.

Frank H. Simonds

The passing of a great mind fortified by a facile pen is always untimely; when it occurs in a "winter of discontent" it is extremely so. Thus the death of Mr. Frank H. Simonds on January 23, 1936, is a loss of the first magnitude to be felt in an especial way now when his crystaline thinking is so much needed. Army Ordnance shares in the general sorrow attendant upon his death. He was a contributor to the pages of this Journal and only recently had indicated that he would soon honor it with another contribution.

Honored by many foreign governments, Mr. Simonds had gained an acquaintanceship with world conditions and the often unseen forces which shape policies so that he became historian and commentator of the first rank. He knew the military-economic connotations of national policies, combined with an accurate evaluation of military strategy, produced in his writings analyses which were direct and true.

Just before his death Mr. Simonds raised his voice to urge a sensible attitude on the much discussed problem of the day—neutrality. And somehow we feel that this cause as well as the many others of military significance in which he was expert is, in his death, now deprived of a degree of sanity it can ill afford to lose. No greater tribute to this foremost American commentator could be desired than that the clarity and realism of his views be incorporated in the policies by which we are to proceed. He was an historian of the first rank whose gift of analyzing peace and war in the light of politico-economic forces we will have lost too if we forget his logic. He gave the answer to "Can America Stay at Home?"

The Five Year Program

An Editorial

PRESENT world events, if they are convincing the thinking man of anything other than good or bad statesmanship and clear-cut or bungling action, have certainly brought to the forefront of public attention the function of armies as such and the role of their military equipment. In such a situation a good purpose will have been achieved if sober thought is given to our own military needs and to the best methods of insuring that they are provided for.

Realizing full well that any individual or any group which claims to be concerned about armament is subject to the silly charge that a war scare is being preached for ulterior purposes, these comments are made entirely in a spirit of efficiency and effectiveness for what we call the Army of the United States. The principles which have governed it—and for that matter every professional army of like nature in the history of the world—are simple. They anticipate a definite mission as required by some particular situation. The effort required, the manpower to be utilized and the armament that will be necessary are the result of professional diagnosis. Unfortunately for us Americans the profession of arms ranks low in popular esteem. This is not a reflection on the individuals who compose our defense services, it reflects no discredit upon their high purpose, their loyalty or the results of their work. The lowness of the popular estimate arises purely from ignorance on the part of the popular mind—a characteristic, it seems, of democracies in relation to things military. The fact remains that in matters of national defense the bootblack generally considers himself as competent as, and the ward politician far more so than, the professional soldier whose life is devoted uncompromisingly to proficiency in that profession. The time has come when the people as a whole might well renounce pipe-dreams and look at their army in a very realistic way, prepared to support any sane program advanced professionally.

BEFORE he relinquished his high command as Chief of Staff of the Army, General Douglas MacArthur presented his final report for the fiscal year ending June 30, 1935, which contains a thorough analysis of our present military status. Typical of the man and his excellent foresight, General MacArthur recommended a much needed reëquipment of certain components and proposed a method for doing so. If adopted as national policy, this program will bring about two desirable results. The first of these will be a degree of rearmament without which our present force cannot be said to be effective for possible emergencies that may confront it, and the second will be an efficient and economical method of procuring the things that are required. The proposal, as submitted by the former Chief of Staff, is contained in his 5-year program of procurement. The program as recommended is as follows:

"Munitions—To attempt to supply within a single year all of the Army's immediate requirements in modern weapons and equipment would involve a needlessly costly method of attaining satisfactory efficiency in this important item. Greater efficiency and economy would be secured by spreading procurement over a reasonable number of years. By adopting this method each annual increment comprehends all technical improvements previously developed and automatically maintains a constantly increasing trend in quality. In this way, also, manufacturing costs are minimized since producers may anticipate steady rather than rush orders, while extensive factory modifications, always required when large amounts of specialized equipment must be produced rapidly, are unnecessary. Congress should prescribe a 5-year program of procurement with the understanding that thereafter a reduced schedule of development and replacement would be permitted so as to sustain efficiency. Governed by this mandatory program, the War Department would submit yearly to Congress detailed analyses of the items recommended for immediate procurement.

"Briefly, the concrete objectives, other than those pertaining to the Air Corps, that should be unfailingly attained within the period stated are—

"Mechanization: One cavalry brigade; two regiments of tanks (infantry); seven separate armored car troops for use with 3 Regular and 4 National Guard divisions of cavalry; thirteen mechanized platoons (scout cars) for Regular regiments of cavalry; seven companies of tanks for use with Regular infantry divisions.

"Motorization: The motorization program of the War Department with respect to both the Regular Army and the National Guard has been worked out in detail. It involves every arm and service, each according to its specific needs, and may be summarized by saying that in every instance where motors have demonstrated an ability to meet normal transportation requirements, their substitution for animals is advocated. About 18,000 vehicles of various types are still required.

"Rifles: One of the new semiautomatic weapons for every rifleman in the Regular Army. This to be immediately followed by a similar 5-year program for the National Guard.

"Artillery: Modification of all field guns pertaining to active units of the Regular Army and National Guard, both for high-speed towage and for increasing flexibility of fire. Experimentation and development programs to continue in the effort to simplify this type of matériel.

"Antiaircraft artillery: Complete equipment for all active regiments of Regular Army and National Guard. To be followed by a similar program to equip all in active regiments of Regular Army.

"Chemical Warfare Service: Sustaining program for continuation of experimentation. Procurement in 5 years of necessary defensive and protective equipment for Regular Army and National Guard at war strength.

"Ammunition reserve: Gradual accumulation in essential calibers to meet the needs of the Regular Army and National Guard at full peace strength for 30 days in active operation.

"Miscellaneous equipment: Infantry mortars, various classifications of machine guns, searchlights, signal equipment, and other essential items in needed amounts for Regular Army and National Guard at full peace strength."

The reference in the above quotation to the requirements of the Air Corps recommends an annual procurement of 800 completely equipped planes. The Baker Board, after prolonged investigation, recommended procurement of 500 planes annually to sustain fully an efficient force of 2,500. The increase recommended by General MacArthur is based upon

a casualty rate of 20 percent yearly due to the rapidity with which this material grows obsolete and to the appalling rate of wastage.

ANYONE at all familiar with our national defense needs will concede that the proposals of this 5-year program do not in any one particular exceed the reasonable and necessary needs of a modern effective army of the United States. In recent years a great deal of progress toward efficiency has been made. Much money has been spent—and logically so—on the improvement of morale. Without morale the best machine will not make an army. Quarters have been furnished at military posts, facilities have been modernized, the strength of the Army has been increased, promotion difficulties have been remedied. Moreover there has been some modernization of matériel. Modern automotive equipment has replaced many of the old trucks and cars that had been doing duty since 1918, some new fighting vehicles have been authorized, field guns of the Regular Army and National Guard have been modernized to a certain degree. This should cause gratification among all the people. For all that, a fighting force of today and especially under our system of a skeletonized army must be self-sufficient in all its elements. Otherwise its great function of performing a definite mission until the needed numbers of the civilian component are mobilized, trained and equipped is only as strong as its weakest part.

Thus when the 5-year program recommends mechanization of one cavalry brigade, two regiments of tanks, seven separate armored car troops, thirteen mechanized platoons of scout cars and seven companies of tanks, it looks to a well-rounded, ready force. The modernization program as it relates to automotive equipment is still far from complete. Eighteen thousand vehicles of various types are yet required. Having adopted a semi-automatic rifle it follows logically that every rifleman should be equipped with one. Field guns with their wooden wheels and metal tires are passée—every one of them in service and in reserve should be modified to meet demands of high speed and flexibility of fire. Antiaircraft artillery and its fire control are among the most pressing needs of our service. Until every active regiment of the Regular Army and the National Guard is equipped with its complete complement of this matériel no one can rest assured that our national defense is in its highest state of effectiveness.

Closely allied to the antiaircraft problem is the need for the necessary defensive and protective equipment for chemical warfare. Great in our industrial potentialities of products, the student of industrial mobilization may well wonder as to our ability to produce gas masks sufficient for the civilian population which would demand them on the first provocation. Military and civilian alike, in this country, are not well versed in protective measures. Most important of all is the program's emphasis of an ammunition reserve. When it proposes a gradual accumulation to meet the needs of the Regular Army and National Guard at full peace strength for thirty days in active operation it takes cognizance of one of the most difficult, and at the same time most necessary, requirements of a modern army.

THE 5-year program of 1935 is not new so far as the general idea is concerned. During the past fifteen years several such programs have been embarked upon but they were greater in the intention than in the achievement. An ordnance 5-year program was suggested some ten years ago but governmental purse strings were being tightened and the suggestion came to naught. At about the same time a 5-year program for the Air Corps was suggested and authorized. It was supported during the first year; the second year it was trimmed, the third year it was trimmed again and by the fourth year the accumulated reductions of the two preceding years had created a condition almost as defective as no program at all. So any program, if it is considered at all, must be taken seriously. Once embarked upon it must not be allowed to dwindle to the point that at the end of the fifth year the plans of the first only have been fulfilled.

NOT only the military status is improved by this proposal but economy is achieved by it. As General MacArthur has pointed out, manufacturing costs are minimized because producers "may anticipate steady rather than rush orders, while extensive factory modifications, always required when large amounts of equipment must be produced rapidly, are unnecessary". And greater even than this, the 5-year program means that having decided on types of equipment long under development our armed forces will actually *have* modern equipment. In this respect it is pertinent to recall that nearly forty years ago the same situation had arisen regarding the fortification of our coast defenses. Colonel Birnie's article in this issue emphasizes the point splendidly. After a long period of investigation, the development of technique and the test of many possible types, the time came in 1888 to call quits on further indefinite experiment and actually to begin to fortify. As was noticed in the last issue of this journal, Colonel Birnie rendered great service when he called for action in producing guns rather than interminable development and test.

All this is strikingly and truthfully summarized by the former Chief of Staff when he writes in his final report: "To maintain in peace a needlessly elaborate military establishment entails economic waste. But there can be no compromise with minimum requirements. In war there is no intermediate measure of success. Second best is to be defeated, and military defeat carries with it national disaster—political, economic, social, and spiritual disaster." Under the several headings of this report there is sketched in rough outline a military establishment reasonably capable of assuring successful defense of the United States. I have this confidence in its ability, although in size the proposed army is not remotely comparable to many now existing and even falls far below the legal limits prescribed in the National Defense Act.

"There are, of course, certain favorable factors which minimize the need in our country for maintenance in peace of a huge military machine such as exists in almost every other major power. Chief among these factors are geographical isolation and the existence of cordial relationships across our land frontiers.

"Additionally influencing the determination of the War Department to emphasize quality rather than quantity in further development of the Army is the conviction that relatively small forces exploiting the possibilities of modern weapons and mechanisms will afford in future emergencies a more dependable assurance of defense than will huge, unwieldy, poorly equipped, and hastily trained masses. Adherence to such a policy likewise serves the interests of economy, since of all costs of war, both direct and indirect, none is so irreparable . . . . as that measured in the blood of its youth."

Communications

THIS NEUTRALITY

THE EDITOR:

Having read in the September-October 1935 number of ARMY ORDNANCE the editorial entitled "This Neutrality," I enclose a copy of a letter of mine which appeared in *The Sun* (New York) of December 10, 1935. What we have most to fear is the "mass psychology," which is like the cackle among geese. The present condition of the popular mind is truly lamentable. While denouncing arms and armament makers, the professed apostles of peace are now seeking to attain their ends by getting us into every international trouble that springs up anywhere in the world. A boy once described to me a very uncomfortable horseback journey he had just made in which, as he said, his horse stumbled into all the holes he saw and into all he did not see. When it comes to assuring perpetual peace by perpetual war, the hidden holes far exceed in number those that are visible.

New York. JOHN BASSETT MOORE.

The copy of the letter enclosed with Judge Moore's communication follows; it is republished with acknowledgement to *The Sun* (New York):

TO THE EDITOR OF THE SUN—*Sir:* With fullest concurrence I read the editorial article in THE SUN of December 3, entitled "Mind Our Own Business!" and that in yesterday's issue entitled "Mr. Ickes Explains." Frank Simonds had a powerful letter in the *Herald Tribune* of yesterday entitled "Our Neutrality as it Affects Italy."

When I read in the press some time ago the public statement which Mr. Ickes was said to have made, but which he now repudiates, threatening, even while the members of the League of Nations were freely carrying on trade with Italy, to blacklist and hold up to popular reprobation Americans who were lawfully shipping oil to that country, I confess that it seemed to me to represent the perfection of lawless inadvertency. In view of Mr. Ickes's disavowal, it is only fair to assume that he himself shares that opinion. Nevertheless, what he was reported to have said was warmly applauded in some quarters as an exemplification of the "new neutrality," which has not yet been officially defined. But, the other day, when some one asked me what the "new neutrality" meant, I replied that, as its limitations appeared to be wholly emotional, it perhaps might be best defined in the terms of the "new chastity," which encouraged fornication in the hope that it might reach the stage of legalized prostitution. In other words, the "new neutrality" appears to be intended to get us into war, which is in a special legal category, by acts which cannot be defended on legal or moral grounds. Nothing is, however, so dangerous to the character and the integrity of a nation as the indulgence, under self-flattering disguises, of sentimental inclinations which have not been subjected to precise analysis.

This morning I see in the headlines an announcement of a new "warning" to Japan in which the Nine Power Treaty is invoked. Being at the moment under great pressure, I have had no opportunity to read what the columns below the headlines contain, but I observe that the protest or warning has been given in conjunction with Great Britain. This causes me immediately to recall the fact that on February 27, 1933, Sir John Simon, then Minister for Foreign Affairs, speaking for the British government in the House of Commons concerning the armed struggle then going on in Manchuria between China and Japan, declared: "Under no circumstances will this government authorize this country to be a party to this conflict." Contemporaneously, I read in *The Times* (London) the speeches made at a dinner given by the Japanese ambassador in London to the new British ambassador to Japan who was about to depart for his post. The Japanese ambassador specially emphasized the intimate ties between the two countries, and did not omit to mention the fact that both countries had monarchial governments as an additional assurance of stable and friendly relations. At the very moment when this atmosphere of fraternity was pervading London and Tokio, our Secretary of State, Mr. Stimson, was, no doubt from the highest motives, doing (to use General Goethals's old phrase) "his damnedest" to bring us into an admonitory and really threatening attitude toward Japan, partly in order to shame the League of Nations into doing its duty. This was loudly applauded and encouraged by Viscount Cecil, whose voice, though then ineffectual at home, was potent here.

Tyler Dennett's "John Hay" (pp. 290-293) shows that Hay's much vaunted "open door" notes were in effect dictated by a British subject named Hippesley, who had served under Sir Robert Hart in the Inspectorate of Maritime Customs in China, and who was then in strategic seclusion at the Holland House, in New York, where Rockhill, in Hay's behalf, conferred with him. At that time the European Great Powers had their respective spheres of interest and military strongholds in China, with a view to the possible break-up. The United States had none, but the notes committed us to coöperation to maintain the *status quo;* and Hippesley adroitly suggested that, in order to avoid any possible criticism of our own administration *at home* for seeming to follow England's lead, we ourselves take the lead by sending the notes to all the powers, including England, and let England follow us. This we did, with the truly ironical result that, as Dennett remarks, "the answers were, without exception, in some greater or less degree evasive"! Such is the proud origin of the romantic supposition that it is the special prerogative and duty of the United States to preserve by force of arms what Hay called "Chinese territorial and administrative entity."

I have no hard feeling toward Great Britain on account of such things. I have always said that, if I let another person take advantage of my folly, I ought rather to congratulate than to condemn him. This attitude on my part would be no less correct if I should advertise myself as being desirous to help all humanity in that sense. But, having largely spent my life in trying to build up international law and to advance the peaceful settlement of international disputes by judicial and diplomatic methods, I am convinced that, as mutual respect is the only sound basis of human relations, we cannot advance our own interests or those of the world by substituting for the American Eagle as our national emblem an unidentified dishcloth for "world service." During the past twenty years, under the influence of a shallow, confused, phrase-intoxicated so-called "idealism," we have more and more tended to do this. The same fatuous notion was incorporated in the war-making machinery of the Covenant of the League of Nations for the *enforcement* of peace throughout the world by united *holy* force. On this there was later bestowed the euphonious name of "sanctions." The natural result is now before us in the form of the steady increase of "peace-enforcing" national armaments for purposes the holiness of which is likely at any moment to be debated by war.

If this letter is longer than I originally intended, perhaps I may justify myself by the plea that it is written with a full heart in the desire to assure you of my deep sense of the service THE SUN is rendering in trying to prevent our country from incontinently entering upon visionary courses which are fraught with danger to the world and are likely to be disastrous to ourselves.

New York. JOHN BASSETT MOORE.

TNT-Filled Shells

The Editor:

Major Marsh in his article, "Ordnance Activities in the Zone of the Interior, Part I" (Army Ordnance July-August 1935, page 45) remarks, in connection with exudation from TNT-filled shells, as follows:

"The exudate is not explosive and the exudation in itself is not a serious matter . . . ." The exudation, or tarry matter, on the contrary presents a very serious objection. In this connection I have published two analyses, "High Explosive and Projectile Burning Ground", and "Tarry Matter".

When the TNT for use in projectiles is not of the first quality, i.e., when it does not have a melting point of 80°C. the exudation will accumulate around the detonating fuze after two months of storage of shell filled with amatol and freshly loaded. Frequently the shell will not detonate and if the storage period was sufficiently long or if there was undue motion during transportation the accumulation of tarry matter is so great around the fuzes that the shells will not explode after firing. This was particularly true of howitzer ammunition for Russian ordnance in 1916. Indeed this condition created a real scandal in Russian ordnance during the early days of the World War and was, in spite of many interventions by myself, before the British Ministry of Munitions in 1915, when I contended that only good quality TNT should be used; material with melting point 79°C. should never be allowed.

Major Marsh further says, in referring to smoke-producing pellets in the bottom of the projectile, "This pellet has been the cause of numerous premature explosions". This is entirely true. I have always raised objection against the use of the pellet especially when TNT does not correspond to the best chemical specifications. I have referred to this in my writings and have outlined the precautions that must be carried out when the pellets are extracted from shells. Here again it must be noted that dangerous chemical reactions have taken place between the tarry matter and the components of the smoke-producing pellet. I was not surprised under such conditions that premature explosions took place in Russian ordnance. This is especially so when red phosphorus is employed as one part of the smoke producer. I found after very careful laboratory investigations that red phosphorus always contained some traces of white phosphorus which later contributed to the chemical reactions between other parts of the smoke-producing composition and tarry matter. Consequently I was not surprised that American 155-mm. Howitzer ammunition has been completely renovized. As such the smoke producer is and was of no value at all for these shells although it had some use in 75s when used within a year after the date of filling.

I look forward with much pleasure to reading the future installments of Major Marsh's series.

Paris — Michael Kostevitch.

The Editor:

The quotations made by Dr. Kostevitch could very readily be misunderstood by one who is not familiar with American ammunition and whose knowledge of the English language is somewhat limited. The quotations meant to convey the meaning that the exudate is not explosive and that the exudate itself does not cause prematures. It is conceded that exudation may possibly result in the projectile being a "dud." Dr. Kostevitch describes the exudate by the phrase "tarry-matter." It is agreed that this exudate or tarry-matter developing on a projectile which is stored fuzed, may result in the malfunction of the fuze and cause the projectile to become a "dud" from that source, if not from the deterioration of the explosive charge, which is indicated in some degree by the exudate itself. However, no American ammunition loaded with high explosive is stored fuzed. All TNT now used in U. S. Army projectiles has a melting point above 80° C.

Dr. Kostevitch has in mind a smoke-producing pellet composed of such materials as to result in a chemical reaction between the explosive charge and the pellet itself. It is agreed that such a condition is fraught with the utmost danger. However, the smoke producing pellet mentioned in the article is not so chemically constituted and the prematures which resulted in ammunition loaded with this pellet were due solely to physical conditions which were found to exist. Chemical reactions did not enter into the trouble.

Raymond Marsh,
Washington. *Major, Ordnance Department.*

A.O.A. Membership

The Editor:

I have been intending for some time to write you in regard to the substance of an editorial appearing in the November-December 1935 issue of Army Ordnance. This editorial starts on page 173. There you ask why it happens that the Army Ordnance Association has such a small membership and very modest income when other organizations mentioned are able to enlist so many members and have such huge budgets?

I believe that at heart you know the answer and are simply asking the question to make others think, or to try and overcome the difficulties the A. O. A. is working under.

I think the fundamental reason for the discrepancy you point out is that so many other organizations are engaged largely in putting out nonsense nicely flavored but with no real meat in it whereas the A. O. A. is (and I believe quite properly) confining its attention to the dissemination of facts by recognized authorities undiluted by window dressing. The result is just one more example of the fact that the vast majority of people would rather be entertainingly fooled than conscientiously undertake to educate themselves, because the former requires no mental effort and the latter does.

As a matter of fact I was a member of one of these organizations for two or three years, back in the 1929, '30 and '31 era and became so completely fed up with what I thought to be the inconsequential drivel they put out that I wrote to their organization a rather nice letter and asked why it was that their publications always sounded exactly like they were digests of the Encyclopedia Britannica and the *National Geographic* plus some current newspaper staff articles? It did not seem to me that they ever came right down to the point of a sound controversial matter, rather pointedly avoided such things, in order to keep out of arguments although it was, and still is, the heart of the international situation which really counts. I received a reply from one of the officials granting in the main that my criticism had some merit but that with all secret negotiations and confidential information surrounding the real heart of the matters, it would be very difficult to obtain, if not inadvisable to publish, the real truths.

I went to several meetings of the organization held for out-of-town speakers, and my impression of its membership was that it consisted largely of a lot of well-to-do ladies with time on their hands, willing to sit over tea cups and think they were deciding the affairs of the nations while some glib talker conveyed the impression he was the right-hand man of all the ruling heads in Europe and excused himself from saying anything pertinent, on the ground that his information was confidential. I can easily see where, with the majority membership of such a type, considerable money can be wheedled out of them and the membership list be accumulated in large proportion.

You raise a very good and important point when you discuss the desirability of increasing the membership and influence of the A. O. A. Under any real pressure, I believe the membership of the organizations of the type I have in mind would "melt like snow in June" whereas that of the A. O. A. would probably be "carrying the ball".

Wilmington, Del. — Ernest N. May.

Association Affairs

PITTSBURGH POST

COL. C. T. HARRIS, JR., Ordnance Department, chief of the Planning Branch, Office of the Assistant Secretary of War, was the principal speaker at a dinner-meeting of the Pittsburgh Post, Army Ordnance Association, and the Pittsburgh Ordnance District held December 14, 1935, at the Pittsburgh Athletic Association. A large delegation affiliated with both organizations was present. The subject of Colonel Harris' address was "Industry's Support of the Military Effort in War."

Mr. Frank B. Bell, chief of the Philadelphia Ordnance District, presided at the meeting. After welcoming members of the district's advisory and contract boards, distinguished guests and Reserve Officers, Mr. Bell introduced Col. H. A. Gidney, president of the Pittsburgh Post and assistant chief of the Pittsburgh Ordnance District. Colonel Gidney gave a splendid résumé of the relationship between and the functions of the district organization and the local post. He outlined the importance of the manufacturing facilities of the Pittsburgh area for industrial mobilization.

Colonel Harris described the methods and procedure now followed by the Office of the Assistant Secretary of War in carrying out its essential mission under the National Defense Act. He told how industrial war planning activities of the War and Navy Departments are coördinated through the Army and Navy Munitions Board, "a virile organization, alert to and conscious of its responsibilities and desirous of effecting real progress in the work assigned to it." He also described the methods by which facilities are allocated to the emergency needs of the Army and Navy, the essential importance of accurate requirements, specifications and standardization, the continuing studies and analyses of commodities and raw materials, contractual procedure, price control and other elements of effective assurance of national defense. After discussing the policies of the Department regarding industrial mobilization as presented by him on behalf of the War Department before the Senate Munitions Committee, Colonel Harris set forth the following principles governing industrial planning to meet war needs:

"1. The War Department is convinced that in the event of war it must depend upon American industry to produce the major portion of the munitions required.

"2. The War Department is planning for and expects the fullest coöperation on the part of industry in this effort.

"3. The War Department is planning for and expects the fullest coöperation on the part of Labor in this effort.

"4. The War Department in its plans contemplates fair but not excessive profits for industry.

"5. The War Department is planning to eliminate competition on the part of Government agencies for the products of industry. These products will be apportioned to the various Government needs by a system of allocation.

"6. The War Department must be prepared to present clearly its side of the procurement picture, that is,—what do we want (specifications); how much do we want (requirements); when do we want it (rate of delivery); and business relations with industry (contract forms).

"7. The War Department believes in the principle of educational orders in time of peace, on the theory that an industry having once produced munitions is better qualified thereafter to produce munitions in war.

"8. The War Department believes that in peace an appreciable portion of munitions manufacture should be accomplished by civilian industry.

"9. The War Department is planning to receive from Congress necessary legal authority to impose, where desirable, the following industrial controls: a. Price fixing; b. Priorities; c. Compulsory orders; d. Commandeering of materials and plants; e. Licensing; f. Apportioning commodities and raw materials. It must be understood that the power to exercise these controls must be available. It does not necessarily follow that all these controls will be imposed.

"10. In order to marshall all the national resources in support of the military effort, plans must call for the creation of certain national superagencies which will act directly under the President. An example of this type of superagency control may be cited in the war-time War Industries Board.

"11. In industrial planning the needs of the civilian population must receive due consideration.

"12. In order that industrial planning for a war effort may be effective, it is mandatory that the War and Navy Departments participate equally in the work.

"The Planning Branch is now fourteen years old. Much has been accomplished and there is every reason to believe that future progress will be more rapid, and that the organization will have justified its existence in more orderly and prompt procurement of supplies if this country should ever be so unfortunate as to be involved in another war."

The concluding address at the meeting was by Maj. L. A. Codd, Ord. Res., executive secretary of the Army Ordnance Association, the title of whose talk was "Pillars in the Temple of Peace." Following the addresses a sound moving picture of the exhibits and demonstrations at the Seventeenth Annual Meeting of the Association at the Aberdeen Proving Ground was shown for the first time. This film is easily the best that has ever been produced by the Signal Corps. In clarity, continuity and spoken description it presents a clear exposition of the importance of industrial preparedness. Maj. H. C. Minton, secretary of the Post, assisted by a committee of members and Reserve Officers, was in charge of the meeting.

ST. LOUIS POST

IN tribute to Col. M. E. Singleton, chief of the St. Louis Ordnance District, a testimonial dinner was tendered him by the St. Louis Post of the Army Ordnance Association on January 6, 1936, at the Park Plaza Hotel, St. Louis. The occasion was a birthday celebration marking Colonel Singleton's transfer to the Auxiliary Reserve.

Col. Harry Scullin, president of the St. Louis Post and assistant chief of the St. Louis Ordnance District, was toastmaster. He conveyed the congratulations and thanks of all those interested in ordnance in the St. Louis District to Colonel Singleton for his many years in war and peace as head of the district organization.

Brig. Gen. Herman W. Schull, Assistant to the Chief of Ordnance and Chief of Manufacture of the Ordnance Department, delivered the principal address. He praised Colonel Singleton's work and conveyed the congratulations of the Chief of Ordnance. General Schull emphasized the important role of the St. Louis area as an element of our national defense from the ordnance standpoint. He thanked Colonel Singleton as the representative of the Ordnance manpower and industrial power for its great share in the ordnance record during the World War and for the coöperation and interest it has displayed since then. General Schull's address was enthusiastically received by the nearly 200 members and guests who were present.

Mr. Frank W. Carter, a life-long friend of Colonel Singleton, paid tribute on behalf of his fellow St. Louisans to the civic and public-spirited zeal of the jubilarian.

Greetings on behalf of the Army Ordnance Association were extended to Colonel Singleton by the executive secretary, Maj. L. A. Codd, Ord. Res., who spoke on the growing importance of the ordnance movement as the crux of our national defense.

The function was one of the most enjoyable and noteworthy in the history of the St. Louis Ordnance District. A program of professional entertainment added to the pleasantness of the dinner. A committee of members and Reserve Officers headed by Capt. H. M. Reedall, secretary of the post, spared no effort in planning and executing this most delightful gathering. At the conclusion of the addresses Colonel Scullin, on behalf of his associates, presented with thanks and congratulation, a handsome desk set as a constant reminder to Colonel Singleton of the affection in which he is held.

LIEUT. COL. GILBERT P. MCNIFF

LIEUT. COL. GILBERT P. McNIFF, Ord. Res., chief of the Manufacturing Service of the Pittsburgh Ordnance District, died December 21, 1935. He was in his 51st year.

LIEUT. COL. GILBERT P. MCNIFF

Colonel McNiff was appointed a lieutenant colonel in the Ordnance Reserve Corps on February 7, 1925. In addition to his assignment as chief of the Manufacturing Service, he was also a member of the Sub-Committee on Shell Forgings of the Advisory Committee on Ordnance Production.

He was graduated from Lehigh University in 1906 after which he entered the employ of the Carnegie Steel Company at Homestead, Penna. In 1912 he became associated with the National Tube Company and at the time of his death was assistant vice president in charge of operations of that company. He was a director of the Pittsburgh Post of the Army Ordnance Association, having been actively interested for many years as a member of the Association in promulgating industrial preparedness. He had devoted considerable time and effort toward processes for speeding ordnance production in time of emergency, his principal field in this respect being the uses of seamless steel tubing to replace forgings in ammunition production. He contributed a very illuminating discussion of this subject in a paper which was published in the January-February 1929 issue of ARMY ORDNANCE. His loss to the Pittsburgh Ordnance District and to the Army Ordnance Association is a great one.

NEW MEMBERS

THE following have recently been admitted to membership in the Army Ordnance Association: W. E. Ackermann, Wheeling, W. Va.; Edw. J. Albert, Philadelphia, Pa.; Benjamin S. Albertson, Jr., Lewes, Del.; J. H. Albrecht, Cleveland, Ohio; C. T. Almquist, Norman, Okla.; Benjamin T. Anuskewicz, Oxford, N. Y.; A. B. Arganbright, Portsmouth, Ohio; Arthur W. Armstrong, Pittsburgh, Pa.; Wm. Ray Baldwin, Washington, D. C.; Arthur G. Baral, Cleveland, Ohio; Thomas F. Baughman, Clarendon, Va.; R. E. Bevington, Yorkville, Ohio; Jos. M. Bing, New York City; Donald L. Bower, Elmira, N. Y.; W. J. Breckenridge, Mayfield, Ky.; M. L. Brett, Palomar Mountain, Calif.; F. Barton Brown, Los Angeles, Calif.; Steffen S. Brown, Princeton, N. J.; Cecil E. Bryan, Jr., Altadena, Calif.; John A. Cameron, Bristol, Conn.; John Campbell, Kirksville, Mo.; A. G. Carlson, Paterson, N. J.; Charles L. Carroll, St. Louis, Mo.; John F. Cleeves, Berkeley, Calif.; N. E. Cook, Wheeling, W. Va.; Robert Cuse, Jersey City, N. J.; R. C. Diehl, Steubenville, Ohio; Walter L. Dixon, New Brunswick, N. J.; Charles H. Dodge, Nemacolin, Pa.; Francis Edward Doyle, Dorchester, Mass.; Earle S. Eckel, Washington, N. J.; Paul I. Evans, Charleston, S. C.; Albion R. Fletcher, Canton, Mass.; Robert F. Flood, New Rochelle, N. Y.; John Rison Fordyce, Little Rock, Ark.; Chester Frey, Dover, Pa.; Herman C. Fromuth, Philadelphia, Pa.; A. E. Garey, Madison, Wis.; R. E. Gay, Waterbury, Conn.; Geo. McM. Godley, New York, N. Y.; R. J. Goldie, Detroit, Mich.; Archibald W. Green, Auburn, N. Y.; S. E. Hackett, Pittsburgh, Pa.; Walter Halpert, New York, N. Y.; Ronald C. Hands, Rochester, N. Y.; Ralph Happel, Fredericksburg, Va.; Alton G. Hendrick, Auburn, N. Y.; John W. Higgins, Worcester, Mass.; John H. Hinrichs, Aberdeen Proving Ground, Md.; Fred S. Hird, Des Moines, Ia.; Arthur O. A. Hodge, Torrance, Calif.; M. Fred Hubbell, Maplewood, Mo.; W. T. Ingram, Trenton, N. J.; C. H. Jeffers, Fort Monroe, Va.; Loren M. Jenks, Washington, D. C.; H. C. Jennison, Waterbury, Conn.; Kenneth M. Jones, Long Branch, N. J.; Robert W. Jordan, Philadelphia, Pa.; B. W. Keese, Oshkosh, Wis.; Michael C. Kennedy, Marion, Ind.; Charles L. Kern, Kansas City, Mo.; Geo. P. Kraemer, Philadelphia, Pa.; Robert C. Lang, Princeton, N. J.; F. H. Limeburner, Philadelphia, Pa.; K. S. Lindsay, New York, N. Y.; Carson Linebaugh, York, Pa.; S. C. Lloyd, Penns Grove, N. J.; David Luria, New York, N. Y.; Firman R. Lyle, Washington, D. C.; Charles W. MacGregor, Cambridge, Mass.; E. E. MacGuffin, Youngstown, Ohio; Byrne C. Manson, Pasadena, Calif.; Charles J. Mason, New Hampton, N. Y.; George Frederick Mayse, Azusa, Calif.; C. E. McConnell, Jr., Princeton, N. J.; Fred L. McDonald, Bismarck, N. D.; David E. McGraw, Pittsburgh, Pa.; Everett J. Miller, Hartford, Conn.; A. L. Milton, Yorkville, Ohio; Lowell J. Moeller, Towson, Md; B. C. Moise, Pittsburgh, Pa.; Robert R. Moon, Chico, Calif.; G. T. Moore, Oshkosh, Wis.; J. Hase Mowrey, Chambersburg, Pa.; J. E. Myers, Steubenville, Ohio; Britton A. Nicol, Los Angeles, Calif.; J. C. Nix, Washington, D. C.; James Nixon, Dover, N. J.; Wayne S. Palm, Reading, Pa.; C. W. Peterson, Princeton, N. J.; John J. Pickett, East Lynn, Mass.; J. C. Raaen, Washington, D. C.; Charles B. Richmond, Bradford, Pa.; Charles E. Ripley, Dover, N. J.; Walter F. Rockwell, Detroit, Mich.; Willard F. Rockwell, Detroit, Mich.; Wm. I. Rose, Boston, Mass.; Philip G. Rust, Granogue, Del.; Harold W. Shonnard, Upper Montclair, N. J.; John F. Speight, Richmond, Va.; A. F. Stoeger, New York City; Fred I. Story, Beverly Hills, Calif.; Wm. B. Sweet, Washington, D. C.; Jerome K. Swinford, Houston, Texas; L. A. Taylor, Wheeling, W. Va.; L. M. Van Gieson, Dover, N. J.; F. R. Van Rensselaer, Morris, N. Y.; Ame Vennema, Rexton, Mich; Burgess P. Wallace, Brooklyn, N. Y.; C. Robert Weiller, Chicago, Ill.; Burling D. Wells, Danbury, Conn.; Frederick A. Wiecking, Indianapolis, Ind.; Kenneth E. Witmyer, Lititz, Pa.; R. L. Womer, East Alton, Ill.; John E. Woods, Brookline, Mass.; and August J. Zimmerman, Rochester, N. Y.

NECROLOGY

SINCE publication of the last issue of ARMY ORDNANCE notice has been received of the death of the following members of the Association: Ralph H. Aronson, Summit, N. J.; Charles N. Black, San Francisco, Calif.; Charles F. Cowdrey, Sr., Fitchburg, Mass.; G. C. Davison, Lyme, Conn.; Horrace Hammond, Birmingham, Ala.; A. S. Henry, New York, N. Y.; Charles B. Jacobs, Waterbury, Conn.; J. Lovell Johnson, Fitchburg, Mass.; Fritz P. Lindh, New York, N. Y.; F. L. Pierce, Milwaukee, Wis.; and T. M. Russell, Middletown, Conn. To relatives and friends of these deceased members ARMY ORDNANCE, for its readers, extends condolences.

Professional Notes

FLORIDA AIR FORCE MANEUVERS

THE Florida concentration and maneuvers of the GHQ Air Force, held during December, 1935, were the first attempted by Maj. Gen. Frank M. Andrews since the organization of the Air Force in March of last year. The data collected are being evaluated and conclusions and recommendations are being formulated. These will become the basis of the future development of the Air Force. General Andrews' original plan called for a "within twenty-four hours" concentration of the modern aircraft elements of the force from their home bases at March Field, Calif., Barksdale Field, La., Selfridge Field, Mich. and Langley Field, Va. The concentration of all combat units was completed within twenty-two hours and fifty minutes without the loss of a single unit. On the day following the arrival of the three wings at Vero Beach, Miami Municipal, Ft. Pierce and the Air Force Headquarters at Chapman Field, a ten day period of intense activity began. Each unit flew from one to three missions per day and the communications of the Air Force were put to a severe test. The exercises provided a wealth of material from which communication plans for the future can be made.

The temporary bases on the Florida East Coast utilized in these maneuvers were improved by the Service Squadron dispatched by motor and air from Langley Field and Barksdale Field with the coöperation of local civilian officials. The successful utilization of such temporary bases speaks very well for the high state of training of the personnel, especially of the Bombardment Wing at Vero Beach. General Andrews and his staff utilized every opportunity to study the available civilian facilities for the servicing of aircraft. On December 9th, General Andrews piloted an amphibian airplane to the Pan-American base at Miami, inspected that very complete and elaborate installation and observed the arrival of Pan-American Clippers from Carribbean ports.

The interest of the public in Florida in the Air Force, its maneuvers and equipment, increased from day to day as evidenced by the demand for staff officers to address civic groups at luncheon and dinner meetings and the response from news broadcasts by wing commanders and members of the Air Force and wing staff. The coöperation and cordiality of civilian agencies was exceptional and will long be remembered by those members of General Andrews' command who were responsible for details of communications, supply and arrangements for shelter. Lieut. Col. R. L. Maxwell, Ord. Dept., Ordnance Officer of the Air Force and former editor of this Journal, was in charge of public relations during the concentration and maneuvers.

LIAISON, 1917

AS did our distinguished contemporary, *The Royal Army Ordnance Corps Gazette*, in which the following article was published (November, 1935), ARMY ORDNANCE puts on the record this pleasingly reminiscent account of British-American Ordnance relations, 1917-1918:

"It is perhaps worth while to put on record an interesting and satisfactory instance of liaison, between the R. A. O. C. and the United States Ordnance Department, at Havre in 1917.

"Towards the end of that year the U. S. A. sent over to France a vanguard to pick the brains of the Allied Armies and see what could be done before the arrival of the main body. To Havre, on 28th December, 1917, came the two Ordnance Officers: Major Harry B. Jordan and Captain Edward S. Toothe. It happened that the C. O. O., Havre, Colonel (now Brigadier-General) J. G. Austin was on leave and the writer had the pleasure of meeting them and showing them round. The first afternoon was spent at the work-shops at the Usine Deutsch and at dinner—the best time for such matters—we talked long and earnestly. They were tremendously keen and were good enough to say that they admired the British tremendously, and they were splendidly anxious to profit by our experience and to start from the state to which we had attained by three years of war experience. The writer was much impressed by their charming humility of attitude and quickness of perception.

"The next day was spent at the stores depot at Bassin Bellot and at the Returned Stores Depot (then called the Receipts Depot) at Graville, which was some five miles out and a mile beyond the Workshops. Conversations continued at lunch, tea and dinner, and at the end of the day they came to the flattering decision that they would recommend that the U. S. Ordnance Department should adopt the British system complete as it stood.

"The writer turned this over in his mind in the night watches, and before they left next morning he made a proposal to them: that they should send two officers and about 50 N. C. O's to the C. O. O., Havre, for a month's intensive course. He thought that with their existing knowledge and by specializing in pairs, a pair to each group or branch, they could thoroughly master our procedure. Major Jordan and Captain Toothe were pleased with the suggestion and said that they would submit it to General C. C. Williams, their Chief Ordnance Officer (corresponding to our D. O. S.), so we parted more as friends than as acquaintances.

"In due course the plan was approved and on Feb. 5th, 1918, there arrived Captains Frederick H. Keller and Christopher Cudmore and 52 N. C. O's. They were all picked men and were simply magnificent material; the majority of the enlisted men were college graduates, and it was a real pleasure to teach them. The plan was for the two officers to spread their time over the whole installation—a day or two in every group and branch—while the N. C. O's spent two days on getting a general idea of the whole and then the rest of the month on intensive specialisation, in pairs, in one group or branch, so that as a whole body they would know all the work of the depot. They set to work with a will and took copious notes and copies of all forms used and made graphs of the disposal of each form. The writer asked them to let him have any criticisms or suggestions on the system and details thereof. The result was both surprising and gratifying; instead of the large number of criticisms he expected from such keen fresh brains, he only received some three or so, of which two had already been tried out and found impracticable or inadvisable. It looked as if there was not much wrong.

"Off they went at the end of their month, and in course of time an invitation came for me to go and see how they were getting on with it. However, it was difficult to get away and the months passed, and it was not until the end of October, 1918, that an opportunity occurred to take advantage of the repeated invitations and then it was done *en prince*. The writer was asked to bring another officer, and the A. D. O. S. (P.), Lieut.-Colonel (now Brigadier) E. Davidson, took advantage of the chance. There arrived for us: Major Harry R. Kutz, U. S. Ordnance, to conduct us; a sergeant stenographer for our notes; a corporal chauffeur; and a magnificent 8 cylinder Cadillac, and off we purred, intending to stay away for a week. That night we reached Tours, the H. Q. of the L. of C. of the A. E. F., and next morning were introduced to General John H. Rice, the new "C. O. O." of the A. E. F., General Williams having been sent home to become Chief of Ordnance U. S. Army. He asked

what we would like to see. We replied that we would like to see as much as possible. He therefore suggested that we should start at the base port at Bordeaux and go right up the L. of C. and have a look at their front line arrangements. This sounded gorgeous, so the writer wired to the C. O. O., Havre (Colonel Gregson) 'for a week's absence please read a fortnight' and off we went, and were most kindly and hospitably treated throughout. It was most interesting to see how well they had got on and were functioning. We got back to Paris on 9th November, 1918, and the Armistice was expected next day. We longed to stay and see the fun there, but decided to be virtuous and pushed on to Havre that night.

"The liaison had been entirely felicitous and is still unbroken. The writer is still in close touch with Colonel Harry B. Jordan who now holds a very important appointment, that of Commandant of the Army Industrial College at Washington.

"L. L. H."

GAGES IN WAR AND PEACE

FROM the time that the Bureau of Standards was organized in 1901 the Division of Weights and Measures each year has tested and standardized precision length standards and measuring instruments for the several branches of the Federal Government and for industrial concerns. This work gradually increased, and by 1916 the testing of contact length standards, micrometers, and screw thread gages, was sufficient to keep two men constantly employed.

Because accurate gages are a vital necessity in the manufacture of munitions this work was expanded to a large degree in 1917 in order to provide for the many demands of the War and Navy Departments and of manufacturers having contracts for war material. This led to the organization of a new section within the Division of Weights and Measures which is now well known throughout mechanical industry as the Gage Section of the National Bureau of Standards. Started as a war activity, this work has become an important peace-time service to industry.

The first appropriation for gage standardization was granted by Congress on June 15, 1917, and subsequently appropriations have been made annually for this work.

In the year ending June 30, 1918, there were tested and certified or rejected 27,865 gages, of which 85 per cent were for the United States Army. Of the total, 60 per cent were classed as plain gages (plain plug, ring, and snap gages), 20 per cent as profile gages (complicated templets, chamber gages, and fixture gages), and about 20 per cent as screw thread gages. In the next year the number of gages tested increased to 40,630, of which a much larger proportion, 45 per cent, were screw thread gages. Since then the testing of screw thread gages has continued to be a major activity of the Gage Section. To expedite this large volume of testing there were, in addition to the laboratory at headquarters, three branch gage-testing laboratories, which were located in New York, Cleveland, and Bridgeport, Connecticut. These branches were discontinued after the end of the War.

However, as stated in the Annual Report of the Bureau for the year ending June 30, 1920:

> "The need for gages and gage inspection did not cease with the ending of the war. Wherever interchangeable manufacture is carried on limit gages are needed, and the adequacy of the gaging system employed may be taken as a fair measure of the success attained in interchangeable manufacture. One of the principal reasons why the United States leads the world in the manufacture of automobile products is that manufacturers in this country have more nearly grasped the importance of gaging in interchangeable manufacture. It has been said that the wonderful production records made by our manufacturers during the war were due in a large measure to the fact that the United States Government insisted upon the proper use of gages. The use of gages is no less important in peace than in war and should be encouraged and fostered in every possible way."

Representative examples of the importance of limit gages in interchangeable manufacture are these: The production and inspection of the Springfield Army rifle requires the use of 1263 gages; a machine gun about 2200 gages; and one make of automobile about 15000 gages. The Ordnance Department of the War Department has under its charge in the various Arsenals more than 500,000 gages, the replacement value of which is about $30,000,000.

It is obvious that the most effective use of gages by industry can be secured only if all manufacturers and users of gages have access to the same ultimate standards. This object is promoted by the testing and certification of gages by the Bureau. For such services fees are charged to cover the cost of the work.

That industry has found this service to be of real value is shown by the fact that the variety of gages and mechanical parts tested by the Bureau has continued to increase since the War, and the volume of work to remain comparatively steady at about 3000 items per year. There is an increased tendency on the part of manufacturers to require careful inspection of certain gages and tools which formerly were accepted without any question as to accuracy.

An early example of this tendency was the requirement for increased accuracy in gear hobs. Manufacturers of gears by the hobbing process began to feel the effects of keen competition with gears made by other processes, especially ground gears, and in attempting to improve the quality of their product they were inclined to require a rigid inspection of the hobs used.

There was also a tendency to reduce the tolerances on gages used to inspect work, which in turn increased the difficulty of determining whether a particular gage was within the tolerance specified. Accordingly, one of the first steps taken when permanent quarters were made available to the Gage Section was to install an insulated and thermostatically controlled constant temperature room to be used exclusively in gage testing. There also began a progressive movement in the accuracy of the equipment used for measurement of gages.

Foremost among the master gages which the Bureau has tested and certified are precision gage blocks used by gage, machine tool, small tool, automobile, and many other machinery manufacturers as dimensional standards. This work is shared by the Gage and Interferometry Sections. Sets of gage blocks are maintained by the Bureau as standards, with which sets submitted for test are compared by light interference methods. These standards are checked periodically by measuring their lengths directly in terms of wave-lengths of monochromatic light. For highest precision certification, a few gage blocks submitted for test are also so measured.

For more than ten years the Bureau has coöperated with the American Petroleum Institute to establish and maintain standards for oil-well casing threads and other screw threads for oil-field equipment. The Section measures and certifies master plug and ring thread gages made to represent the standards adopted. The Bureau is custodian of the sets of grand master gages. Three sets of regional masters, which are used to check inspection gages, are deposited at convenient stations. These are rechecked periodically by the Bureau. Thus uniformity and complete interchangeability of such threads is secured throughout the country.

Wires for measuring pitch diameters of screw thread gages are frequently measured and certified. Occasionally master lead screws for machine tools are thoroughly investigated as to errors in the screw.—*Industrial Standardization and Commercial Standards Monthly, November, 1935.*

Ordnance Field Service

THE INFANTRY DIVISION ORDNANCE MAINTENANCE COMPANY, PART I

(Organization, Functions and Operations.)

By MAJ. RAYMOND MARSH, *Ord. Dept., U. S. Army*

IN considering Ordnance service in the Infantry Division, and the organization, functions, and operations of the Infantry Division Ordnance maintenance company, let us recall that the mission of this service is to carry out its assigned duties in such a manner as to increase the combat efficiency of the Army as a whole, and that the measure of its efficiency is its capacity to function effectively in serving the combatant arms.

It is my firm conviction that the Infantry Division Ordnance maintenance company constitutes the backbone of Ordnance service for the army. The Infantry Division is the basic unit of which corps and armies are formed. It is the smallest unit composed of all the essential arms and services that is designed to be tactically and administratively self-sustaining. It is the smallest unit that can conduct by its own means, operations of general importance. It is the unit of combat and maneuver. The army succeeds or fails in its mission as the division succeeds or fails in its mission; and the division succeeds or fails in its mission, to a large degree, as its Ordnance service for matériel, service, supplies and ammunition, succeeds or fails in increasing the combat efficiency of the army as a whole and in functioning effectively in war in serving the combatant arms. In addition to the individual importance of these companies, they are more numerous than any other category of Ordnance units. Of the two hundred and seventy-odd Ordnance units to be mobilized under a general mobilization, one hundred twenty-seven of them are medium maintenance units.

IT is always interesting and usually instructive to study the historical background of existing institutions. The history of the development of the Ordnance maintenance set-up is no exception. It is a story the main theme of which is the increasing complexities and diversification of the armament and equipment of the modern army. The Ordnance Department, as such, was established by the Act of May 14, 1812, and was to consist of one Commissary General of Ordnance, an Assistant Commissary General, four Deputy Commissaries, and as many Assistant Deputy Commissaries, not exceeding eight, as the President might deem necessary, a maximum total of not more than fourteen officers. By an Act of February 8, 1815, the Department was reorganized, its duties were defined, and its strength fixed at twenty-four officers and as many enlisted men as the Secretary of War might deem necessary. In this same Act, the Chief of Ordnance, subject to the approval of the Secretary of War, was authorized to organize and detail to regiments, corps, or garrisons, such numbers of privates of the 1st class, furnished with the proper tools, carriages, and apparatus, as may be necessary, and to make regulations for their government. This apparently was the first step in the development of an Ordnance field service. However, that service was short-lived, because by virtue of an Act of March 2, 1821, the Ordnance Department, as a separate institution, ceased to exist. It was merged with the Artillery and the duties pertaining to Ordnance service seem to have been performed by artillery officers detailed for that purpose.

Eleven years later, however, the Department was reconstituted, with a strength of fourteen officers and not more than two hundred fifty enlisted men, and in the same year there was authorized an Ordnance Sergeant for each military post, whose duties were to take care of ordnance, arms, ammunition and other military stores. This appears to have been the second step in the development of an Ordnance field service. The Department has existed continuously since 1832, and has suffered the same ups and downs that the rest of the Army has. In 1846, the Chief of Ordnance was originally authorized to enlist as many master armorers, master carriage makers, master blacksmiths, artificers, armorers, carriage makers, blacksmiths, and laborers, as the Secretary of War might direct. This was another step in the development of an Ordnance maintenance service. What action was taken under that original authorization, I have been unable to find out. This original authorization was amended and modified in subsequent years but the basic authority remained the same until long after the Civil War. Reorganization acts with respect to the Ordnance Department were enacted in 1866 and 1874, the latter of which continued unchanged until 1899. As a result of the Spanish-American War, additional reorganization took place through Congressional action in 1901 and 1906. This legislation was finally superseded by the National Defense Act of June 3, 1916. From this brief résumé of the history of the Ordnance Department, it appears that up till 1916, the only field representatives of the Ordnance Department were the few officers who might have gotten away from arsenals, and the Ordnance sergeants authorized for each post, camp, or station.

PRIOR to the World War, the only mobile field unit contemplated in the Ordnance Department organization was the so-called Ordnance depot, which was set up by an Ordnance Department General Order in 1912. This general order provided that upon the outbreak of war, or when war might be imminent, Ordnance depots would be established at or near the camps of concentration in which the mobile forces of the United States were being collected. This same general order also provided that when an army or field army, or separate division or brigade, was operating in the field in time of war, an Ordnance depot would be established at the base of operations, and sub-depots would be established at such points along the line of communications and elsewhere, as circumstances might require. Some ten or twelve pages of this general order are devoted to the duties, functions and responsibilities of the commanding officers of such depots, among which we find that "he will also make such provisions for the cleaning, preserving and repairing of Ordnance matériel in the hands of troops in the field as may be practicable." The last paragraph of this general order invites attention of all concerned to certain publications, etc., with which they should be familiar. Among this list appears the major items of matériel with which the Army of those days was then equipped. This matériel included the 3-inch field gun matériel, the Maxim automatic machine gun, cal. .30, M1904, the automatic machine rifle, cal. .30, M1909, the Springfield rifle, cal. .30, M1903, the Colt revolver, cal. .38, the Colt revolver, cal. .45, M1909, and the automatic pistol, cal. .45, M1911. Apparently it was considered at that time that if an Ordnance officer were familiar with the details of this limited amount of matériel, he was competent to discharge all of his duties with mobile troops. In another Ordnance Department general order of the same year, the organization of an Infantry, Cavalry, or auxiliary division Ordnance depot was set up. The entire personnel authorized totaled only twenty, including one officer, twelve enlisted men, three civilian laborers, and four civilian specialists, increased by temporary details of one mechanic from each Field Artillery regiment and one artificer from each Infantry and Cavalry regiment served. This same order then continued for some nineteen pages to list office supplies, stationery, pamphlets, forms, carpenters' tools, miscellaneous tools, and spare parts.

The Ordnance Department in two "Notes on Ordnance Field

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Service", published in the summer of 1917, elaborated more upon the organization and operations of this so-called Ordnance depot. It was conceded in these notes that, to operate a depot by the services of mechanics detailed from organizations served, was unsound. Experience with the Punitive Expedition in Mexico the year previous had indicated that small reliance could be placed on assistance derived from this source, because of the fact that organizations needed their mechanics in the field more than at any other time, and consequently in their resistance to losing their services, detailed men of inferior qualifications. Furthermore, it was admitted that by taking repairmen from their organizations in the field, the work which they might have done in their organization, if not detailed away from it, would have to be done eventually at the depot with resultant delay, increased work, and increased expense for transportation. It was therefore considered, tentatively, to increase the depot organization to a strength of four officers and one hundred forty-eight men, eliminating entirely civilian personnel. The depot was organized into four divisions—administrative, accounts, supply, and inspection. The supply division included a storehouse branch and a repair branch. The inspection division, in addition to such functions as were appropriate to such a division, was responsible for instruction of all personnel requiring instruction in the operation and maintenance of Ordnance matériel. It is rather amusing at this time to refer to these pamphlets published in 1917, and read in connection with this instruction work that it had to deal "almost entirely with instruction in regard to machine guns". With respect to maintenance, these notes made the very significant statement, true then and still as true today, that "the maintenance of equipment is the principal, most important and likewise the most difficult function of the Ordnance depot." Provision was also made for the salvaging of all unserviceable Ordnance matériel, no matter where found. This salvage work included not only the recovery of our own matériel but also the overhauling of captured arms and equipment for possible use against the enemy.

This Ordnance depot organization existed until after our entry into the World War, and when our first Division went to France, hasty plans were made to provide in it the Ordnance depot as contemplated by these above cited references. The personnel was organized to include repairmen, machinery was purchased for their use, and a stock of supplies, including the supplies authorized for one of these so-called depots at the time, was ordered to the Port of Embarkation. This organization actually reported to the Division Commander in New York in early June, 1917. Upon receiving this report, however, the Division Commander said that he did not want a depot in the Division and from that moment, as far as the A.E.F. was concerned, the Division Ordnance depot ceased to exist, and the Ordnance Department was left with a blank slate. However, as a preliminary step, the 1st Division Depot established Ordnance sections in the base at St. Nazaire and Nevers, depots in the Division training area at Gondrecourt, and at the artillery camp at Valdahon, and ultimately a repair shop at Issur-Tille.

The mobilization of the U. S. Army on the Mexican border, and the Punitive Expedition in Mexico in 1916 were not considered a sufficient disturbance of our peaceful relations with our next-door southern neighbor to warrant the creation of any of the so-called Ordnance depots and none was created. It is true that our equipment at that time did not require extensive shop facilities for repairs in the field. Each basic unit carried with it as a part of its field equipment, a supply of spare parts for the maintenance of its Ordnance equipment, and such additional spare parts and necessary repairs as were required were furnished by the nearest permanent Ordnance establishment. Nevertheless, the heavy concentration of troops on the border, and the distance of the border from our Ordnance establishments made necessary the creation of some field repair agencies, and mobile repair units operated largely by civilian personnel were set up

in different places along the border. These served to indicate the advantage of such mobile repair facilities and provided invaluable training for personnel in the maintenance of Ordnance equipment in the field. The success of these units and the value of the work which they accomplished was such that upon our entry into the World War, the mobile Ordnance repair shop was created.

AT the time of our entry into the World War, each organization had a small complement of enlisted Ordnance personnel attached to it. Apparently, these detachments were originally created by virtue of War Department General Order No. 34, 1916, which provided that "for the proper care and preservation of Ordnance property, there will be assigned to organizations of the mobile Army and to Coast Defenses, enlisted men of the Ordnance Department as rapidly as they become available", to the extent of twenty-five sergeants of Ordnance, forty-eight corporals, and one hundred privates, 1st class. This original provision was subsequently modified late in the same year by adding the additional function of affording "assistance to officers charged with accountability for Ordnance property". The number of Ordnance enlisted men detailed to these organizations was somewhat increased as a result of this same order. These detachments were again increased as a result of War Department General Order No. 99, 1917. At that time, however, the entire Army was in the throes of reorganization and expansion, and, in War Department General Order No. 109, August, 1917, we find the first mention of the authorization for the organization of a mobile Ordnance repair shop. The Army was being reorganized at that time in accordance with what was known as Tables of Organization, series A, 1917. In these tables, we find this mobile Ordnance repair shop consisted of forty-four men and three officers. Its technical equipment included repair trucks and supply trucks. This organization was attached to the Infantry Division ammunition train, whose enlisted personnel, it is interesting to note, came from the Field Artillery. In addition to this so-called mobile repair shop the ammunition train had a detachment of one officer and twenty-three enlisted men of the Ordnance Department. Throughout the Division, however, there were officers and enlisted men of the Ordnance Department attached to regiments, machine gun battalions, machine gun companies, trench mortar batteries, and in fact to practically every type of unit. These totaled in the aggregate, about one hundred officers and enlisted men.

This organization and assignment of Ordnance personnel remained practically the same until the reorganization immediately after the Armistice, when the mobile repair shops became known as Ordnance maintenance companies, and the basis of the present tables of organization for these companies was set up. Since that time, the organization of our maintenance units has remained essentially the same. No changes have been made to accommodate them to either the changes in organization of the Infantry Division which they serve, or changes in the matériel equipment of that Infantry Division. At a result, it can be said now, as General Williams himself said back in 1928, that while matériel has advanced in complexity, maintenance facilities have been at a standstill. Among some of the more important changes which have occurred in the organization and equipment of the Infantry Division, we may list the following:

(1) A regiment of 155-mm. howitzers has been added to the Divisional Field Artillery brigade.

(2) The types and proportions of automotive weapons have been changed and increased.

(3) All field trains have recently been motorized.

(4) One regiment of 75-mm. guns in each division has been motorized.

(5) Supply functions have also been added to the company.

(6) The prime movers of motorized artillery are still in a state of flux.

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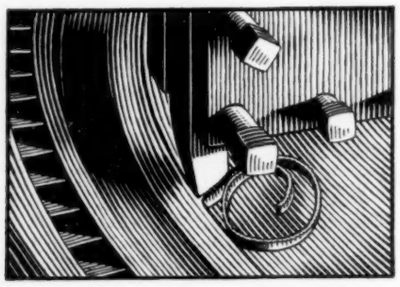

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(7) There is no satisfactory and definite division of responsibility for 3rd and 4th echelon maintenance of automotive matériel between the Ordnance Department and the Quartermaster Corps.

And thus it happens that the basis of our present Infantry Division maintenance company is a table of organization approved in 1921 for peace, and in 1929 for war. But the situation is not altogether without hope. Within the past few months vigorous steps have been taken to improve, expand, and modernize the organization, personnel, and equipment of our maintenance company to bring it in harmony with present organization and equipment of our Army, instead of being based, as it now is, on the organization and equipment of our division as constituted in the early post-Armistice period after the World War.

HAVING thus covered the historical background of our present Divisional maintenance set-up, let us see what are the functions of our Divisional Ordnance units, what facilities are available for the performance of these functions, how they are organized and equipped, and how they operate. The obligations imposed upon the Division Ordnance Officer form the basis of the functions of the Infantry Division maintenance company. This company comprises the only means at the disposal of the Division Ordnance Officer to meet his obligations. These obligations are set forth in the Staff Officers' Field Manual, which lists the duties of a unit Ordnance staff officer as follows:

(1) Command, insofar as relates to operations, of Ordnance troops not assigned or attached to subordinate units.

(2) Adviser to the Commander and the Staff in Ordnance matters.

(3) Supply of ammunition (as far forward as the refilling points) and other Ordnance equipment and supplies.

(4) Operation of Ordnance storage, maintenance, and repair facilities, including salvage and repair of Ordnance matériel.

(5) Technical inspection of Ordnance equipment.

(6) Supervision, within limits prescribed by his commander, of Ordnance activities in subordinate units.

(7) The collection of information concerning Ordnance matériel.

From this compilation of duties, it is possible to group the maintenance company's functions under four headings—namely, inspection, supply, maintenance, and salvage.

Inspections, it must always be borne in mind, are for the purpose of discovering difficulties of the combat troops and increasing the combat efficiency of the troops by remedying these difficulties. Further, it is only by means of the technical inspection of Ordnance equipment that an Ordnance officer acquires the exact knowledge for carrying out his mission for supplying his units. It is evident that unless conditions are known, proper supply is impracticable. Consequently, inspections must be used solely for the purpose of giving more efficient and complete Ordnance service to the division. It must always be accomplished through command channels, and Ordnance personnel should not inspect units of any command without previously reporting to all the commanders concerned, showing their authority and asking the coöperation of the organization to be inspected. I know of no action which can so adversely affect the value of an Ordnance inspection as a violation of these fundamental principles of military courtesy and command. During combat, Ordnance inspection is a continuous operation. Every effort is made to determine before the actual need arises, the repairs and supplies which a combat unit will require. These supplies and the necessary repair facilities should accompany inspecting parties to enable prompt filling of needs when they have been determined. Thorough and formal inspection should be made of the Ordnance equipment in all units, both before and after combat to determine the necessary supplies and repairs required. So far as practicable, the repairs determined to be needed at these inspections, should be effected at the

bivouac of the unit being inspected. Unserviceable matériel which cannot be repaired by the inspecting party and the repair personnel with them, should be withdrawn and should be replaced immediately or arrangements for prompt replacements made. Needless to say, as a result of these inspections, complete information should be given to the commanding officer of the unit involved. This information should include shortages detected, repair work performed incident to the inspection, repair work to be performed by the organization, and repairs which must be effected elsewhere by maintenance organizations having available more time and more elaborate repair facilities.

THE question of supply I touched upon generally in my article on Ordnance Activities in the Theater of Operations. (Army Ordnance, November-December, 1935). Supply functions have been imposed upon Ordnance companies only since the World War and within the last few years. There has been no material revision of supplies carried with the company and no additions of the necessary supply personnel made to meet this obligation. The Ordnance maintenance company carries with it a certain amount of spare parts and complete assembled items. The normal employment of these complete assembled items is for the replacement of unserviceable items as they are turned in to the company for repair. Nevertheless, this stock of items does constitute a small supply of equipment and matériel which is available for supply purposes. During action, however, the requirements for general supplies for the individual may be almost completely met from salvage. Requirements for supply of organizational items of equipment is in an entirely different category. The very nature of these items prevents any appreciable supply of them being carried with the maintenance company. Consequently, the maintenance company must meet its obligation for the supply of these items primarily through the exercise of its repair facilities in maintaining in a serviceable condition the organizational equipment in the hands of organizations. Should it become necessary, during combat, to replace any of these items of organizational equipment, it appears logical to assume that they will be replaced not from stocks which are transported continually with the organization, but that replacement will be effected by the Ordnance company sending some of its personnel and the necessary transportation back to a supply point in the rear,—as, for example, an army depot or a railhead,—and there obtain the required items and actually deliver them to the organization which has the need for that supply. A survey of the authorized loads of the several service trains in the army will indicate that practically no major items of organizational equipment are carried in that reserve. The loads are limited to rations, ammunition, and spare parts, to be used primarily in effecting field repairs. It thus appears that in accomplishing its supply function, except for items of individual equipment, the main role to be played by the maintenance company will be that of delivery.

MAINTENANCE, it may be emphasized, is a phase of supply and a very important one. It is a phase of supply in that it receives unserviceable items as they are turned back into the channels of supply, repairs them and returns them through the same channels to the organization without the necessity of having such unserviceable matériel go back either to the source of manufacture or to some of the elaborate repair shops in the communications zone. The nearer to the troops that this repair can be effected, the less will the channels of supply in the rear be loaded down with items which are merely being shipped back and forth.

The only limitation which may be put on the amount of repairs to be effected by these advanced maintenance units is the limitation imposed by availability of time and repair facilities. Where the repairs required are of such a scope as to be beyond the capacity of the equipment and the time available in the division maintenance unit, the damaged article is evacuated through army installations and the regulating station to the repair shops in the

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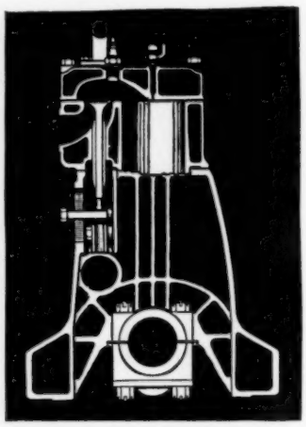

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communications zone. If, however, the article may be repaired within the time available but by using a piece of machine tool equipment larger than is in the division unit, then this article may be taken to the heavy maintenance company of the corps, whose equipment is larger and somewhat more extensive. The heavy maintenance company of the corps backs up the medium maintenance company of the division only in this respect. There is no regular flow of unserviceable items from the division to the corps shops, and no regular flow, in the reverse direction, of repaired items from the corps shops to the division shop. Consequently, the bulk of the work which is beyond the capacity of the division maintenance unit is evacuated to the communications zone directly through army installations and the regulating station.

WITH respect to salvage, the regulations at the present time, are in a very confusing and scattered state and if one were to look in those regulations for the authority for Ordnance salvage service and any information as to how this service should be organized and operated, I fear that the search would leave only greater uncertainty and confusion in the mind of the searcher. Such portions of our Field Service Regulations as are still in effect deal with salvage only insofar as it sets forth injunctions as to its necessity as a means of economy, and the conservation of matériel. Some few general remarks as to the method of operation of a salvage service are set forth. In the Staff Officers' Field Manual, it is provided that the installation and operation of the salvage service is one of the duties of a unit Quartermaster; and also that the duties of a unit Ordnance officer include the salvage of Ordnance matériel. Existing Army Regulations set forth the principle that the Quartermaster Corps is charged with the salvage and disposition of all waste materials and unserviceable property, and that all unserviceable property will be turned over to the Quartermaster Corps for salvage except those articles whose disposition is covered by specific instructions from the War Department. The greater mass of Ordnance items is covered by these excepting instructions and all items of Ordnance equipment listed in S.N.L.'s as expensive items may be disposed of only in accordance with instructions issued by the Chief of Ordnance.

In our current Mobilization Regulations a considerable section of the pamphlet on the subject of supply is devoted to the subject of salvage. There it is provided that when an article of equipment not assigned to the Quartermaster Corps for storage and issue comes into the hands of a Quartermaster in an unserviceable condition, he will immediately communicate with the nearest authorized representative or agent of the arm or service to which the item is assigned for storage and issue, with a view to determining if the article can be further utilized either through reclamation or by use of its parts in the repair or reclaiming of other equipment, and if the decision is in the affirmative, the article in question will be turned over to an appropriate agency of the arm or service involved. These Mobilization Regulations apply primarily to operations in the Zone of the Interior, but nevertheless, they set forth better than any other regulations the intent of a salvage service, no matter what branch of the War Department may be responsible for its installation and operation. When all is said and done, however, enough authority actually exists or may be implied to authorize salvage of Ordnance matériel by the appropriate agencies wherever that matériel may be found. In division areas, first aid stations and dressing stations are points where large amounts of individual equipment quite naturally collect. Groups from Ordnance companies should be sent to such stations to collect this equipment and start it on its return, after being put into a serviceable condition, to the using arm or service. In the trail of advancing troops, additional quantities of Ordnance matériel of all kinds will be found. These, of course, should be collected, made serviceable, when practicable, and held to meet the calls of the using services; otherwise, they should promptly be evacuated to the rear. (*To be continued in the next issue.*)

Book Reviews

WAR CLOUDS IN THE SKIES OF THE FAR EAST. By Tom Ireland. New York: G. P. Putnam's Sons. 1935.

TO the broadcasting of news comments over Station WJAY, Cleveland, is due the interest in the Far Eastern problem that caused the writing of this book, so Mr. Ireland says in his foreword. For this inspiration, readers will be profoundly grateful because this volume is without question a material contribution to the literature on the Far Eastern question. It is not an original study, but it is a splendid collection of data, arguments and other information on this subject, carefully referenced and authenticated, and meticulously impartial.

Just why the American attitude toward Japan is what it is, is somewhat hard to trace and perhaps to justify, in view of the fact that the American nation stirred Japan out of her medieval slumbers and started her on the road to her present industrial, economic, political and military status. It is not hard to learn why Japan looks with suspicion on the Far Eastern activities, principles and interests of the United States.

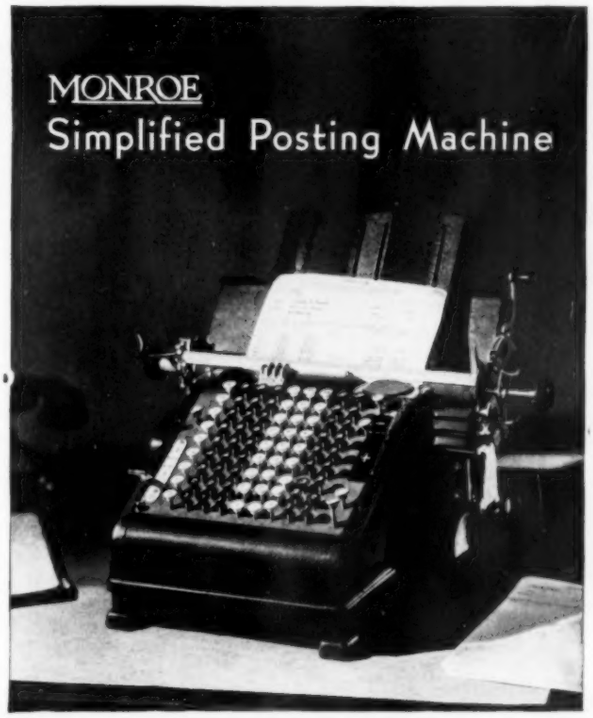
After the Russo-Japanese War it was the United States that limited Japanese gains. After the World War it was the United States that restricted Japanese profits. At the Washington Naval Conference of 1922, it was the United States that led in persuading Japan to relinquish a newly gained position in China, to accept a position of naval inferiority and to give up an alliance of twenty years' standing with Great Britain. Then came the Japanese Exclusion Act of 1924. And now the United States is the leading exponent of a strong, unified and independent China. And so the list of things which, to the Japanese, look decidedly anti-Japanese, could be continued to include the proposal for the internationalization of the South Manchurian Railway, the evacuation of Siberia, protests over the Manchurian episode, refusal to recognize Manchukuo, and insistence on naval inferiority.

Regardless of the development of the American and Japanese attitudes toward each other, it is a fact that Japan, with her rapidly increasing population, is economically dynamic, cannot be held in a static role and happens to be the first nation to prove the fallacy of the theory of national sterility and immobility as the basis for world peace, so stoutly maintained by those who would preserve the *status quo* throughout the world. As Mr. Ireland puts it, "Since the restriction of the growth of population . . . is outside the realm of diplomatic possibility, the only alternative . . . . is war."

He concludes that the United States must either change its attitude toward Japanese aims in the Far East or else must engage in a naval race that may lead to war and that "our small-mindedly meddling, instead of our open-mindedly viewing both sides of the Manchurian question in the Far East, may set the world afire."

In developing this conclusion, the author reviews recent Oriental history, describes the "open-door" policy, its origin, development and present status; he shows the status of American trade and financial interests in the Far East; he traces the development of Philippine independence; he briefs the attitude of the several European powers on the Far Eastern situation with particular reference to their support of either the United States or the Japanese position; and he discusses at considerable length the limitation of naval armaments and its effect on the Orient.

This book is considered particularly valuable for those connected with the military services. It is complete, impartial, authoritative, and up-to-date. R. M.



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THE MAKING OF A SOLDIER: LETTERS OF GENERAL R. S. EWELL. Arranged and Edited by Capt. Percy Gatling Hamlin, M.D., Medical Corps, Maryland National Guard. Richmond, Va.: Whittet & Shepperson. 1935. $1.50.

IN his introduction to the present volume, the author attributes to General Fuller of the British Army the statement that "twenty-three thousand books and articles have been written on the Civil War" and that "the impartial history of the struggle is yet to be written." This might well be said of the World War or of any other tremendous conflict. The truth seems to be that such a history is a practical impossibility from the very immensity of the subject. It would have to be a mere summary, barely skimming the surface or else a tedious and droning tome. The result of this situation seems to be that the student who wishes to achieve a fairly comprehensive and impartial view of so vast a subject, must rely upon reading at least quite a few of the smaller works on the subject.

The best method of approach to military history seems to be the biographical. In this field, "The Making of a Soldier" is an interesting and worthwhile, though perhaps a somewhat limited, contribution. By basing his book so closely upon the letters of General Ewell, Captain Hamlin somewhat restricts his work to their scope. This is perhaps the more noticeable because so much of General Ewell's not very voluminous correspondence deals largely with personal and family matters. Still, this forms a very valuable guide to the temperament and character of the writer. The author has arranged the text extremely well and his criticisms and interpolations are quite searching. The introduction, including as it does the criticisms and comments of British officers who are interested in the question as well as those of Captain Hamlin, forms a truly valuable appreciation of General Ewell's war-time record. A splendid little summary of General Ewell's whole character is given in a short stanza from Stephen Vincent Benet's "John Brown's Body," which Captain Hamlin has chosen for the fly-leaf of his book. It is so good that we quote it in its entirety:

"Ewell goes by,
The little woodpecker, bald and quaint of speech,
With his wooden leg stuck stiffly out from his saddle,
He is muttering, 'Sir, I'm a nervous Major-General,
And whenever an aide rides up from General Jackson,
I fully expect an order to storm the North Pole,'
He chuckles, and passes, full of crochets and courage,
Living on frumenty for imagined dyspepsia,
And ready to storm the North Pole at a Jackson phrase."

The most stringent criticism of the volume under review might well be of the comparatively small space (32 of 154 pages) devoted to General Ewell's Civil War days. It seems to this reviewer that this period, constituting as it does the main reason for our interest in General Ewell, should have been considerably extended by comment, appropriate reference or otherwise. But despite this shortcoming, "The Making of a Soldier" is an extremely well put together little volume. It presents a penetrating view of the life of one of America's outstanding commanders and of the great events in which he had a part. Then, too, those parts of the book which deal with other than the fateful years of '61 to '65, throw valuable sidelights on the early history of the country, particularly of West Point and of the western frontier.

Taken altogether, "The Making of a Soldier" is an interesting and enlightening little book. The reviewer feels sure that most of its readers will join with him in hoping that Captain Hamlin will soon give us another, and perhaps more ambitious work, along the general lines of the present volume.

For the delight of readers of ARMY ORDNANCE—and Ordnance officers in particular—we give the following gem of unconcious humor from a letter written in 1839 by Cadet Ewell to his mother, in which he discusses the advantages of service with the various arms, we quote verbatim: "The Ordnance (Colonel

Bomford's Corps) would be the most desirable on every account, but this requires friends at Washington. The officers receive a third more pay, *have nothing to do,* and have more privileges than any others in the army." What a whale of a difference a few years make! F. W. F. G.

THE UNITED STATES IN WORLD AFFAIRS IN 1934-1935. By Whitney H. Shepardson in collaboration with William O. Scroggs. New York and London: Harper and Brothers. 1935. $3.00.

THIS work is another example of the growing interest of the people of the United States in the progress of world affairs. Sentimentally we may be isolationists, absorbed in our own housekeeping, securely insulated by distance from the vigorous, grasping nations. In point of fact we have never had an opportunity to enjoy our fancied solitude, as every major war since the seventeenth century has drawn us into its vortex. Now, having become a wealthy state of a hundred and thirty million souls, with a foreign commerce that for twenty years has exceeded that of any other country, it is fatuous to expect that we can stand idly by while dynamic events proceed under our noses. It is a healthy sign that discussions of international matters are beginning to attract a larger share of popular attention, for this is an indication that the literate portion of our people are becoming conscious of the extent to which their welfare depends upon foreign relations.

The authors have accomplished a brief and vivid digest of current events that should draw grateful acknowledgments from all but the most voracious of readers. There is little in the book that could not have been gleaned from good daily newspapers supplemented by some of the more informative magazines, but here the labor of gleaning has been performed by Messrs. Shepardson and Scroggs, and right carefully have they done their parts. There is a welcome absence of effort to convert the reader to any particular viewpoint, as well as a laudable indifference to treading upon favored toes. The facts, or what appear to be facts, are stated with a warning that the whole truth is not available; the authors refer to their book as a "first draft of history." As such, the student of military affairs cannot afford to regard it as other than a reference of considerable merit. For him, the first chapter which discusses the reversion of international relations to a pre-war aspect, has a particular significance in pointing out present tendencies. Italy's Ethiopian adventure is carried up to the first week in October, 1935. The various disarmament agreements are reviewed in a way that is calculated to minimize the confusion that only the specialist can avoid. And a chapter on American neutrality indicates the direction that we as a nation hope to follow, with a few hints regarding the obstacles in our path. The part dealing with our internal problems such as gold, silver, trade reciprocity, and foreign debts is of special value. The appendix contains a chronological list of happenings of these two trying years, and in addition other data of importance as reference material. The book is recommended without qualification. J. M. E.

THEORY OF ALTERNATING CURRENT WAVE-FORMS. By Philip Kemp. Pittsburgh: Instruments Publishing Company. 1935. $4.50.

THIS is Volume 1 of a series of monographs on electrical engineering under the editorship of H. P. Young. The aim of the series is to enable engineers, advanced students and others to obtain authoritative works on special and important subjects which are generally either ignored or inadequately dealt with in standard textbooks.

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waves were not understood or, more accurately, because the experimental side of the science had not advanced sufficiently to effect theoretical conclusions. With general advance of knowledge, and particularly in practical oscillography, greater interest was awakened with the realization that the gap between sinusoidal alternating currents and those actually met with in practice was a considerable one in a great many cases.

Other volumes in the series of monographs are in preparation. Taken as a whole they should be of untold benefit to the rapidly progressing science of electrical application. O. E. D.

MODERN SHOTGUN SHOOTING. By Lawrence B. Smith. (Lon Smith) New York: Charles Scribner's Sons. 1935. $2.50.

THE author of this small volume is a well known writer of sporting books and a New York sportsman. It is well agreed that it is next to impossible to cover in one book all phases of shotgun shooting. To cover it in a small volume of 171 pages and do it well becomes an extremely hard task. We must congratulate Mr. Smith on the method of approach and the choice of material he has placed in his book. He has arranged it so that it is most interesting reading.

The book consists of nine chapters divided as follows: I. Modern Shotgun Shooting; II. Guns and Ammunition; III. Gun Fit; IV. Gun Handling and Care; V. Clay-Target Shooting as Practice; VI. Safety Rules and Shooting Courtesy; VII. Field Trial Shooting; VIII. Hints to Shooting; IX. Hints to Skeet. There is an appendix containing much information in a condensed but not omitted form.

It must be realized that to cover the subject of guns and ammunition alone in 20 pages is almost impossible. Mr. Smith has accomplished his purpose in touching the high spots and in getting the student started correctly. Throughout the book the author makes it quite clear that the only method and procedure in becoming a good shot, is to procure first a custom-made gun with a stock to fit—if it is a stock gun, to "butcher" it until it fits. A person starting out in the shooting game will buy a stock weapon regardless of how much advice he is given to the contrary. This is partially due to the efforts of the sales people and to necessity that on the average only enough funds are available to purchase the regular factory product. Arms made to order or with special stock measurements, important as they are, add considerably to the cost of the gun. To get a true picture of the types of guns used in the field by the average hunter one only need accompany such a group. The majority will be found to be stock guns and quite a few of the mail-order variety. The beginner would be better benefited had he been advised outright to purchase the best he could afford, as it is only through experience that one begins to know what he wants in the measurements of a stock. The average of us will do well if we have one custom-made gun during our life-time without going about having a number of them made until we finally get the one that really fits. It was probably the author's thought to bring out these points but it is only by reading somewhat between the lines that they can be recognized.

On pages 16 and 17 Mr. Smith goes into a lengthy discussion of the manufacture of shot, pointing out that chilled shot is made of lead and antimony, fluxed with an arsenic compound. In about the same breath he points out that the use of copper-coated shot may have a detrimental effect on the flesh of game. Why either shot will have an effect is more than this reviewer can see. In consulting a toxicologist on this point, I was informed that there would not be any ill effects to a human being on eating the flesh of game shot with either type of shot. Mr. Smith seems to forget that the men at the Western Cartridge Company have been using copper coated shot for over ten years, have stored game as long it was legal to do so, ate it and are still quite alive. Also, that our game bullets and military bullets are coated with a jacket material that is about 90 per cent copper.

If there were any ill effects or poisonous compounds resulting from wounds from these projectiles they would not be used for game shooting or military purposes. Apparently the author is taking a 'crack' at the companies loading this type of shot shell. No shooter need to worry about such matters as long as the shell fits the gun, gives the patterns he wants and when he does his part performs as it should.

The only other serious criticism that might be made is the poor illustrations used in the fore part of the book. It is quite apparent that these pictures were taken by the author with a hand kodak. Had he taken more pains in arranging his background and had as good composition in the illustrations of the guns as he has of the stances, the book would appeal to the average person to a greater extent. After Chapter IV the pictures are well done, they illustrate the points of the text and are a revelation after looking at the first series of photos.

The exposition on the use of clay targets for practice, the fact that trap shooting is a highly specialized sport and that skeet is rapidly approaching such, are well discussed. Much is said in their defense as well as the faults being made known to the reader. The chapter of field-trial shooting is well worth the cost of the book as it gives the problems of the "gun" in this work.

The appendix contains much information on shot patterns, shot sizes and number to the load, gun dimensions, safety rules, skeet rules and the weight of American game birds. Ten pages are devoted to "English Observation on Shooting and Charts on Ballistics, Etc.," which is most interesting to the American sportsman. He generally cannot or does not sanction the British form of shooting. This section carefully brings out the points as to what is different in the two types. It will present to the American sportsman the problems that are present for the English followers of the shotgun.

Those who follow the shotgun and enjoy the days in the open with fur and feathers will find this book the most complete for its size ever offered shotgun shooters. H. E. S.

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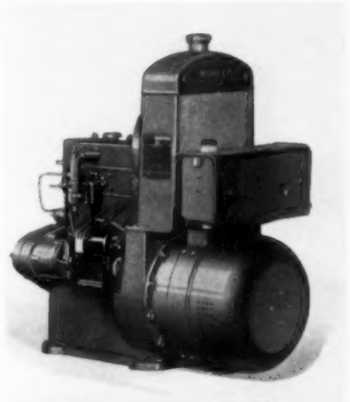

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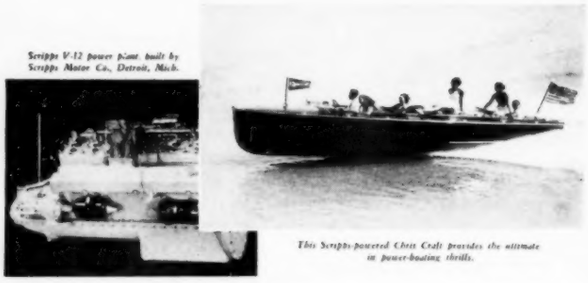

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